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W. Kennedy

THE
Meaſurer's Guide Enlarg'd:
OR, THE
Whole ART
OF
Meaſuring
MADE
Short, Plain, and Eaſy.

Containing full Directions how
to Meaſure

1. Any Plain Superficies.
2. All Sorts of Solids; with particular Inſtructions for meaſuring of Timber, *&c.*
3. All Sorts of Artificers Work, *viz.* Carpenters, Joyners, Plaiſterers, Painters, Paviors, Glaſiers, Bricklayers, Sawyers, Maſons, Earthwork.
4. The Art of Gauging: Being of ſingular Uſe to Ingineers, Gentlemen, Artificers, and others.

The Second Edition.

By JOHN BARKER, Ingineer.

LONDON: Printed for *Samuel Ballard*, at the
Blue-Ball, over againſt the *Pump*, in *Little-*
Britain. 1718.

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TO THE

READER.

T*HESE Sheets were compoſed for my own private Uſe, Thirty Years ſince, I not in the leaſt intending to Publiſh them, but at the Importunities of ſome Friends, not without Reluctancy, I, agreed to have them Printed as they were, not having then leiſure either to add to them, or reviſe and correct* *them as they ought, by which means ſeveral Miſtakes crept into them, and ſeveral Things were omitted that would have rendred them more compleat. Theſe Diſadvantages, with the Book, being printed on extraordinary bad Paper, did not hinder the Sale of Twelve Hundred Copies, and they being (now it is become ſcarce) frequently enquired after.*

At the requeſt therefore of the Bookſeller, *I have not only corrected the Errors of the Firſt Impreſſion, but made very large Additions to the whole; ſo that I hope it will be found the compleateſt, and moſt uſeful Book of this kind extant.*

Having endeavoured to render every thing therein as plain as poſſibly I could, that ſo the meaneſt Capacity might be able to learn to meaſure thereby (without the help of a Tutor) Timber, Stone, or any Artificers Work whatſoever.

And as I never thought it worth while to write from a vein of ſcribling, or the Ambition to ſhew my own Parts or Abilities: So I know if it's done Ill, a Man is juſtly expos'd to the Cenſure of every one; and if well, it recommends him but little to the Advancement of his Fortune, which is much better made by leſs painful Endeavours.

But the buſineſs of my Fortune has been far from my Deſign in *the New Edition of this Book, the doing a Good, and a Pleaſure to the Publick have been the ſole Motives: And if it is as well accepted, as I am made to believe it will be, I have all the Reward I expected.*

* * *

I have peruſed this Treatiſe of *Meaſuring*, and believe it to be a very uſeful Book, it being the moſt plain and compleat of any yet extant.

☞ *R. Snow*, Teacher of the *Mathematicks* in *Moorfields.*

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ERRATA.

Pag. 36. lin. 4. for *Signe* read *Sine*. p. 80 l. 23. for 72.41 r. 7441. p. 94. l. 26. for *multiply* r. *multiply it*. p. 103. l. 26. for 16 r. 16.8. p. 104. l. 3. for 16.8 r. 16. p. 114. l. 9. for 84920 r. 2849.20. p. 122. l. 14. for 200.90 r. 200.92. p. 115. l. 23. for 2 *Feet* 8 *Inches* r. 2 *Feet*. p. 167. l. 24. for 7 *Feet* 4 *Inches* r. 6 *Feet* 4 *Inches*. p. 167. l. 26. for 54 *Feet* 10 *Inches* r. 53 *Feet* 10 *Inches*.

THE
MEASURER's GUIDE:
OR, THE
Whole ART
OF
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MADE
Short, Plain and Eaſy.

CHAP. I.

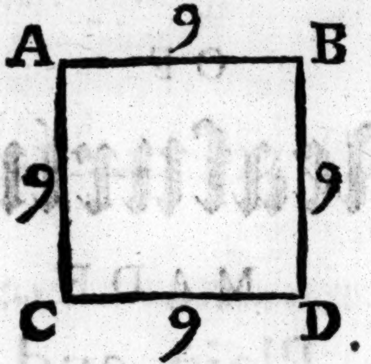
How to meaſure any Plain Superficies.

PROP. I.

H*OW to find the Superficial Content of a Geometrical Square.*

Example.

Admit there is a Square repreſented by the Figure A B C D, whoſe ſides are each Nine Feet, whoſe Area, or Superficial Content is required.



To find which, multiply its ſide 9 by its ſelf, and the Product will be 81 Feet, which is the Content of that Square.

$$\begin{array}{l} 9 \\ \underline{9} \\ 81 \text{ Feet.} \end{array}$$

PROP. II.

How to find the Superficial Content of a Parallelogram, or long Square.

Multi-

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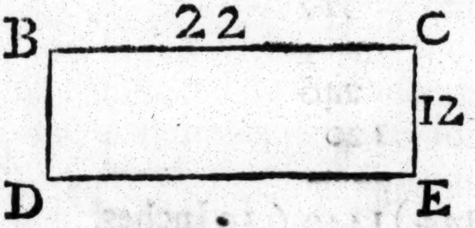
Multiply the length by the breadth, and the Product will be the Content thereof.

Example:

Admit there is a long Square repreſented by the Figure B C D E, whoſe length B C is Twenty two Inches, and breadth C E Twelve Inches, whoſe Content is required.



To find which, multiply the length 22, by the breadth 12, and the Product will be 264 Inches, which is the Content of the long Square required, which you may reduce into Feet, by dividing the ſame by 144, the Number of Inches contained in a ſuperficial Foot, and the Quotient will be 1 Foot, and 120 will remain which is $\frac{120}{144}$ of a Foot, which is 10 Inches.

Inches.
22 The length.
12 The breadth.

44
22

---

144) 264 (1 Foot.
144

120
12

240
120

---

144) 1440 (10 Inches.
144

---

(0)

But this way of Working being very tedious and troubleſome, by reaſon of the Reduction; for your Multiplier, and Multiplicand, muſt be reduced both into the Loweſt Denomination, and afterwards reduced into Feet. I would adviſe the young Artiſt to work by Decimals; and for that end, to provide himſelf of a Two-Foot

Rule, on which each Foot ſhall be divided into Ten equal Parts, and each of thoſe Parts into Ten other equal Parts: So is the Foot divided into 100 equal Parts, and thereby is fit to take the Dimenſions in Feet, and parts of a Foot; by which Rule, if the Dimenſions of the Square in the laſt Example, was taken, the length B C would be 1,83 Feet, and the breadth C E, 1 Foot. Then if you multiply the length by the breadth, as before, the Product will give 1.83, or 1 Foot 10 Inches very near. So is the Content found without any more trouble; which Method I have made uſe of in ſome of the Examples in the following Diſcourſe of Meaſuring of *Superficies* and *Solids*; but in ſuch ſort, as any perſon that underſtands not Decimal Arithmetick, may eaſily apply them to Vulgar Arithmetick. But generally I have given the Examples in Integers or Feet. If it happens, that any long Square Superficies, be broader at one End than at the other, whoſe Content is required, firſt add the two Ends together, and take half their Sum for the true Breadth, and multiply it into the Length, and the Product will be the Content thereof.

Example.

Admit there is a Piece of Glaſs, or any other Superficies, that is 2 Foot broad at one End, and 1 Feet broad at the other, and 6 Feet long, whoſe Content is required.

To perform which, add the two Ends together, *viz.* One Foot and two Feet, and their Sum will be three, the half of which is 1.5 Foot, or One Foot ſix Inches; which multiply into the Length ſix Feet, and the Product will give Nine Feet for the Content required.

2 The breadth at the wideſt End.
1 The breadth at the narroweſt End.

3 The Sum.

1.5 Half the Sum.
6 The length.

9.0 The Content.

PROP. III.

How to find how much in Length of any Long Square Superficies goes to make a Superficial Foot.

Divide 1 by the given Breadth, and the Quotient will give how much of the Length of any Superficies goes to make a Superficial Foot thereof.

Example.

Admit there is a long ſquare Piece of Board, or any other Superficies, whoſe Breadth is 1.32 Feet, and it be required to know how far one ought to meaſure along the ſame, to make a Superficial Foot thereof.

To perform which, divide 1 by the Breadth 1.32, and the Quotient will give .757, which is Nine Inches and ſomething more; and ſo much of the Length goes to make a Superficial Foot, as in the following Work.

```
1.32 ) 1.00000 ( .757
           924
           ———
           760
           660
           ———
          1000
           924
           ———
            76
```

PROP. IV.

How to find the the ſuperficial Content of a Right lined Triangle.

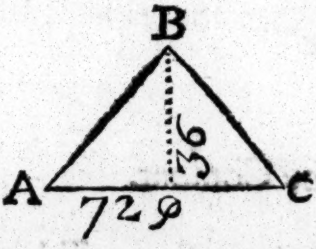
Although Right lined Triangles are of ſeveral Kinds and Forms; as Firſt, in reſpect of their Angles, they are either Right Angled or Oblique Angled, Acute Angled, or Obtuſe Angled. Second, in reſpect of their Sides; They are either an Equilateral, Iſoſceles, or Scalenium Triangle. But ſeeing they all meaſured by one and the ſame Rule, I ſhall add but one Example for all; and take this for a general Rule.

Multiply half the Perpendicular into the Baſe, and the Product will be the Content

tent of the Triangle; or multiply half the Baſe into the whole Perpendicular, and the Product will give the ſame thing: Or, if you multiply the whole Baſe into the whole Perpendicular, half the Product is the Content of the Triangle.

Example.

Admit there is a Triangle A B C, whoſe Baſe A C is 72 Feet, and the Perpendicular B Q is 36 Feet, whoſe Content is required.



To find which, multiply half the Perpendicular, which is 18 Feet, into the Baſe 72 Feet, and the Product will be 1296 Feet, which is the Content of the ſaid Triangle.

Or thus,

Multiply half the Baſe, which is 36 Feet, into the Perpendicular 36 Feet, and the Product will give 1296 Feet, as before, for the Content of the ſaid Triangle.

72 The Baſe A C.
18 Half the Perpendicular B Q.

576
72

1296 The Content.

36 The Perpendicular B Q.
36 Half the. Baſe A C.

216
108

1296 The Content.

To find the Area of any Triangle, by having the three Sides given without the Help of a Perpendicular.

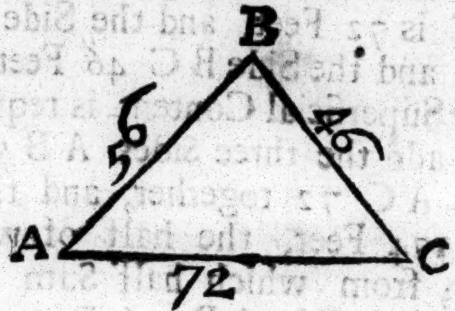
The Rule.

Add the three Sides together, and take half that Sum, then Subſtract each Side ſeverally from that half Sum; which done, multiply that half Sum and the three Differences continually, and out of the laſt Product extract the Square Root, which Square Root ſhall be the Area of the Triangle ſought.

Example.

Admit there is a Triangle A B C, whoſe Baſe A C is 72 Feet, and the Side A B is 56 Feet, and the Side B C 46 Feet, whoſe Area, or Superficial Content is required.

Firſt, add the three Sides A B 56, B C 46, and A C 72 together, and the Sum will be 174 Feet, the half of which is 87 Feet; from which half Sum 87 Feet, ſubſtract the Side A B 56 Feet, and the Difference will be 31 Feet; then from the half Sum 87 Feet, ſubſtract the Side B C 46 Feet, and the Difference will be 41 Feet: Alſo ſubſtract from the half Sum 87 Feet, the Side A C 72 Feet, and the Difference will be 15 Feet; then multiply the half Sum of the three Sides 87 Feet, by the Difference betwixt it and the Side A B, which is 31 Feet, and the Product will be 2697 Feet, which multiply by the Difference between the half Sum of the three Sides 87 Feet, and the Side B C 41 Feet, and the Product will be 110577 Feet, which multiply by the Difference of half the Sum of the three Sides 87 Feet, and the ſide A C 15 Feet, and the Product will be 1658655; then extract the Square Root thereof, and it will give 1287 Feet for the Superficial Content of the Triangle.



		The Difference.
A B	56	31
B C	46	41
A C	72	15

The Sum 174

The ½ Sum 87

87	87	87
56	46	72
31	41	15

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```
         87
         31
         —
         87
      261
    ─────────
      2697
        41
    ─────────
      2697
    10788
    ─────────
    110577
        15
    ─────────
    552885
   110577
   ──────────
   1658655 ( 1287.
   .  .  .  .
   ──────────
22 ) 065
     44
   ──────
248 ) 2186
      1984
   ──────
2567 ) 20255
       17969
   ──────────
       2286
```

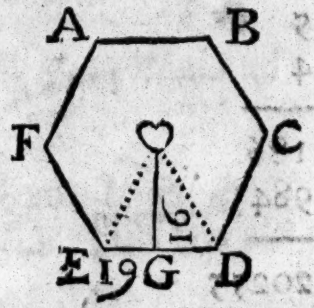
PROP. V.

How to find the Superficial Content of a Polygon, or any equal ſided Superficies.

Multiply the Length of the Perpendicular, let fall from the Center to the Middle of one of the ſides, into half the Sum of the ſides, or half the Perpendicular into the Sum of the ſides, and the Product ſhall be the Content of the Polygon.

Example.

Admit the Polygon given be a Hexagon, repreſented by the Figure ABCDEF (or a ſix equal ſided Figure) whoſe ſide is 19, and the Perpendicular ⊙ G, is 16 Feet.



Multiply half the the Sum of the ſides, which is 57, by the length of the Perpendicular 16, and the Product will be 912 Feet, which is the Content of the Polygon required.

Or,

Multiply the Sum of all the ſides, which is 114, by half the Perpendicular 8, and the Product will give 912, as before, for the Content of the ſaid Polygon.

F
19 The ſide of the Polygon.
6 The number of the ſides.

---

114 The Sum of the ſides.

---

57 Half the Sum of the ſides.
16 The Perpendicular.

342
57

---

912 The Content.

F
114 The Sum of the ſides.
8 Half the Perpendicular.

---

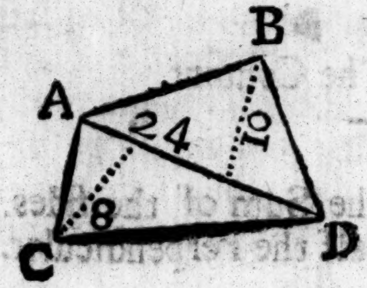
912 The Content.

The reaſon of this manner of Working is very plain, if from the Center you draw the Lines ⊙ E and ⊙ D, thereby making the Triangle E ⊙ D, whoſe Content (by the third Propoſition) is found by multiplying the Perpendicular ⊙ G 16 into half the ſide E D, which is 9.5, and there being in the Hexagon 6 ſuch Triangles, therefore the Perpendicular ⊙ G, being multiplied into 6 times half, the ſide D E produceth 912 for the Content as before.

PROP. VI.

How to find the Superficial Content of a Trapezium, or Table.

A Trapezium is a Figure, conſiſting of four unequal ſides, and as many unequal Angles, as is the Figure following, ABCD.



To meaſure which Trapezium, you muſt firſt reduce it into two Triangles, by drawing the Diagonal Line A D, and ſo is your Figure reduced into two Triangles, *viz.* the Triangle A B D and A C D, then if you let fall Perpendiculars from the two Points B and C, if you find the Content of the two Triangles, and add their Content together, the Sum will be the Area, or Content of the whole Trapezium.

Example.

Having drawn the line A D, and ſo reduced the Figure into two Triangles, and let fall the Perpendiculars from B and C (the Baſe A D is common to both Triangles) admit the Baſe A D to be 24, and the Perpendicular at C to be 8, and the Perpendicular at B to be 10; then, if according to Propoſition the 3d, you multiply 24, the Baſe by 4, half the Perpendicular, the Product will give 96 for the Content of the Triangle A C D.

Likewiſe, if you multiply 24, the Baſe by 5, half the other Perpendicular, the Product will give 120 for the Content of the Triangle A B D.

Then if you add the Content of theſe two Triangles together, *viz.* 96 and 120, their Sum is 216, which is the Content of the whole Trapezium A B C D.

Or thus,

Add the two Perpendiculars, *viz.* 10 and 8 together, and multiply half the *Sum*, which is 9, into the common Baſe A D 24, and the Product will give 216, for the Content of the Trapezium A B C D, as before.

Or thus,

Multiply half the common Baſe A D, which is 12, into the *Sum* of the two Perpendiculars, which is 18, and the Product will give the ſame as before, *viz.* 216, for the Content of the Trapezium.

24 The Baſe A D.
4 Half the Perpendicular at C.

96 The Content of the Triangle ADC.

24 The Baſe A D.
5 Half the Perpendicular at B.

120 The Content of the Triangle ABD
96 The Content of the Triangle ADC

216 The Contents of the Trapezium A B D C.

10 The Perpendicular at B.
8 The Perpendicular at C.

18 The Sum.

9 The half *S*um.

24 The Baſe A D.
9 Half the two Perpendic. at B & C.

216 The Content of the Trapez. ABCD.

12 Half the Baſe A D.
18 The *S*um of the Perpendic. at B & C.

96
12

216 The Content of the Trapez. ABDC.

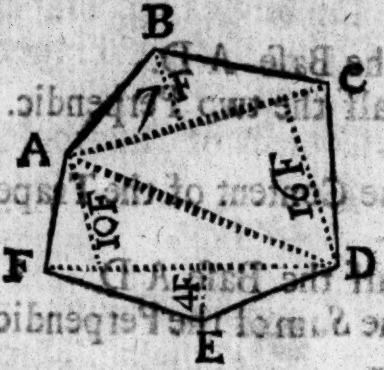
PROP. VII.

To meaſure an Irregular Figure.

Rule.

The following, and the like Figures, muſt be divided into Trapeziums and Triangles; which done, meaſure each Trapezium and Triangle ſeverally, and add the ſeveral Contents together, ſo will the ſum be the Contents of the Figure.

Thus



Thus in the Figure, by drawing the Line A D, it is divided into two Trapeziums A D C B, and A D E F, each of which is divided into two Triangles, by drawing the Lines A C and F D; then work according to the aforegoing Directions, you will find the Content of the Figure to be 458 Feet.

16 Feet.	10 Feet.
7 Feet.	4 Feet.
The Sum 23	The *S*um 14
The $\frac{1}{2}$ *S*um 11.5	The $\frac{1}{2}$ *Sum* 7
A C 24 Feet.	*F D* 26 Feet.
460	182 Feet.
230	
276.0 Feet.	

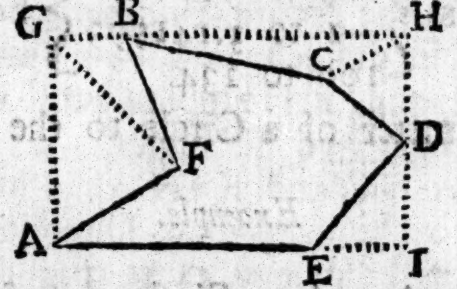
Feet.
276 The Content of the Trapez. *ABCD.*
182 The Content of the Trapez. *ADEF.*

---

458 The Content of the whole Figure.

Or thus,

About the Irregular Figure, deſcribe a *S*quare, as in the following Figure.



And find firſt the Contents of the Square A G H I; then find the Contents of the ſeveral Triangles A G F : B G F, B C H, H C D, D E I, and add them together, and ſubſtract the Sum from the Contents of the Square A G H I, and the Remainder will be the Contents of the Figure A F B C D E.

PROP. VIII.

By the Diameter of a Circle, to find the Circumference.

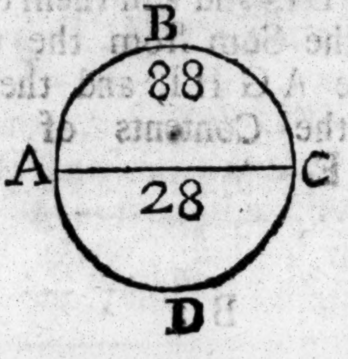
To find which, the Analogy, or Proportions are as followeth:

$$\text{As}\left\{\begin{array}{r}7 \text{ to } 22\\113 \text{ to } 355\\1 \text{ to } 3.141593\\100 \text{ to } 134.\end{array}\right\}\text{So is}$$

the Diameter of a Circle to the Circumference.

Example.

Admit there is a Circle repreſented by the Figure A B C D, whoſe Diameter A C is 28, whoſe Circumference is required.



To find which, work by any of the foregoing Proportions, ſo will you find the Circumference to be 88, as in the following Work.

```
As 7 : 22 : 28
            22
            ——
            56
           56
           ———
        7) 616 (88
           56
           ———
            56
            56
           ———
           (0)
```

PROP. IX.

How by the Circumference of a Circle given, to find the Diameter.

To find which, the Analogy, or Proportions are as followeth.

$$\text{As}\left\{\begin{array}{l} 22 \text{ to } 7 \\ 1 \text{ to } .318309 \\ .355 \text{ to } 113 \\ 314 \text{ to } 100. \end{array}\right\}\text{So is the Cir-}$$

cumference of a Circle to the Diameter.

Ex-

Example.

Admit the Circumference of the foregoing Circle ABCD be given, which was found to be 88, whoſe Diameter is required.

Work by ſome of the foregoing Proportions, and ſo will you find the Diameter of the ſaid Circle to be 28, as in the following Work:

```
As 22 : 7 : 88
             7
           ----
     22)616(28
        44
        ---
        176
        176
        ---
        (0)
```

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P R O P. X.

How to find the Superficial Content of a Circle, having the Diameter and Circumference given. Every Circle is equal to a Parallelogram, whoſe Length is equal to half the Circumference, and the Breadth equal to half the Diameter.

The

The Rule.

Therefore multiply half the Circumference by half the Diameter, and the Product is the Superficial Content of the Circle.

Example.

Admit there is a Circle repreſented by the foregoing Figure, whoſe Circumference A B C D is 88, and the Diameter A C 28, whoſe Superficial Content is required.

To find which, multiply half the Circumference, which is 44, by half the Diameter, which is 14, and the Product will give 616, which is the Content of the ſaid Circle required.

44 Half the Circumference.
14 Half the Diameter.
———
176
44
———
616 The Content.

PROP. XI.

How to find the Superficial Content of a Circle, having only the Diameter given.

All Circles are in Proportion one to another, as are the Squares of their Diameters by *Eucl.* 12. 2. Therefore to perform which, the Proportions are as follows:

$$\text{As}\left\{\begin{array}{l}14 \text{ to } 11\\ 1.27324 \text{ to } 1\\ 252 \text{ to } 355\\ 1000 \text{ to } 785\end{array}\right\}\text{So is the Square of}$$

the Diameter to the Area.

Or otherwiſe.

$$\text{As}\left\{\begin{array}{l}7 \text{ to } 22\\ 113 \text{ to } 355\\ 1 \text{ to } 3.14159\end{array}\right\}\text{So is the Square of}$$

the Semidiameter to the Area.

Example.

Admit there is a Circle, whoſe Diameter is 28, and it be required to find the Content of the ſaid Circle.

To perform which, firſt half the Diameter, the half of which is 14, which 14 multiply into its ſelf, and the Product will give 196, which is the Square of the Semi-Diameter; then work by ſome of the foregoing Proportions, and ſo will you find the Superficial Content of the ſaid Circle to be 616, as in the following Work:

```
  14         As 7 : 22 : 196
  14                      22
 ----                   -----
  56                     392
 14                     392
 ----                  ------
 196                 7)4312(616
                       42
                      ----
                       11
                        7
                      ----
                       42
                       42
                      ----
                       (0)
```

PROP. XII.

How to find the Superficial Content of a Circle, having the Circumference only given.

To find which, firſt ſquare the Circumference, then work by the following Proportions:

As four times 22, which is 88, is to 7; So is the Square of the Circumference to the Area of the Circle:

Or, as 1 is to .07958, ſo is the Square of the Circumference to the Area of the Circle.

Example.

Admit there is a Circle, whoſe Circumference is 88, and it be required to find the Content of the ſaid Circle.

To find which, firſt ſquare the Circumference 88, whoſe ſquare you will find to be 7744, then work by one of the foregoing Proportions, ſo will you find 616 to be the Content of the ſaid Circle, as in the following Work:

```
  88      If 88 : 7 : 7744
  88                  7
 ----                ----
 704          88) 54208 (616
704               528
 ----             ----
7744               140
 ----               88
                   ----
                    528
                    528
                   ----
                    (0)
```

PROP. XIII.

How, by the Content of a Circle given, to find the ſide of the Square, the Superficial Content of which Square ſhall be equal to the Superficial Content of the Circle.

To perform which, extract the ſquare Root of the Content of the Circle, which Root is the ſide of the Square deſired.

Example.

Admit the content of the given circle be 144, and it be required to find the ſide of a Square, the ſuperficial content of whic Square ſhall be equal to the ſuperficial con tent of the Circle.

To find which, extract the ſquare Roo of the content of the Circle 144, whoſ Root you will find to be 12, which is th ſide of the ſquare deſired.

PROP. XIV.

How, by the Circumference of a Circle given, to find the ſide of an inſcribed Square.

To find which, work by the following Proportion:

As 1.000 is to 0.225,
So is the circumference of any circle
To the ſide of the inſcribed Square.

PROP. XV.

By the Diameter of a Circle given, to find the ſide of an inſcribed Square.

To find out which, work by the following Proportion:

As 1.0000 is to 0.7071,
So is the Diameter of any Circle
To the ſide of the inſcribed Square.

PROP.

PROP. XVI.

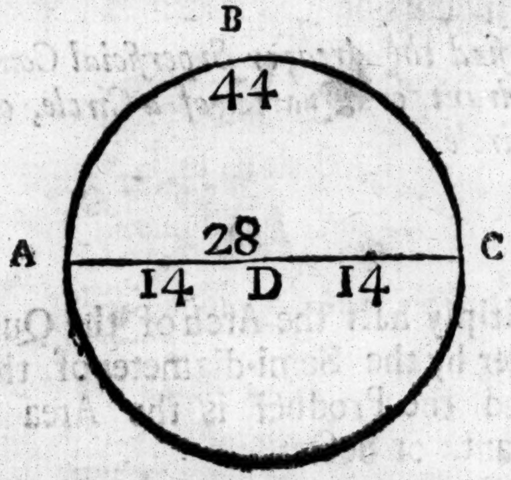
To find the Area of a Semicircle.

Rule.

Multiply the fourth Part of the Circumference of the whole Circle, that is, half the Arch, by the Semidiameter, and the Product will be the Area of the Semi-Circle.

Example.

Suppoſe A B C to be a Semicircle, whoſe Diameter A C is 28, and the half



Circumference A B C is 44, the hal of which is 22, which multiply by the Semi-Diameter A D, or D C, which is 14, and the Product will give 308 for the Superficial Content of the Semi-circle A B C.

44 The Semi-circle A B C.

22 The half thereof.
14 The Semi-diameter A D.

88
22

308 The Area of the Semi-circle ABC.

P R O P. XVII.

To find the Area, or Superficial Contents of a Quadrant, or Quarter of a Circle, or Sector of a Circle.

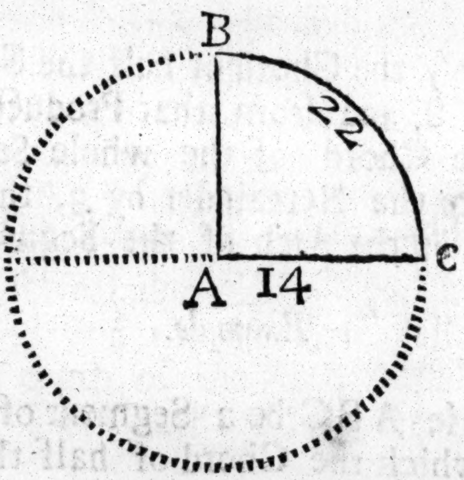
Rule.

Multiply half the Arch of the Quadrant, or Sector by the Semi-diameter of the Circle, and the Product is the Area of the Quadrant, or Sector.

Example.

Example.

Admit A B C be a quarter of a Circle, whoſe Radius, or Semi-diameter A C is 14, and the Arch B C is 22, the half of which is 11, which multiply'd by the Semi-diameter 14, and the Product will give 154 for the Area.



22 The Arch B C.

---

11 The half thereof.
14 The Semi-Diameter A C.

44
11

---

154 The Area of the Quadrant A B C.

By the ſame Rule you may find the Area of any Sector, be it more or leſs than a Quadrant.

PROP. XVIII.

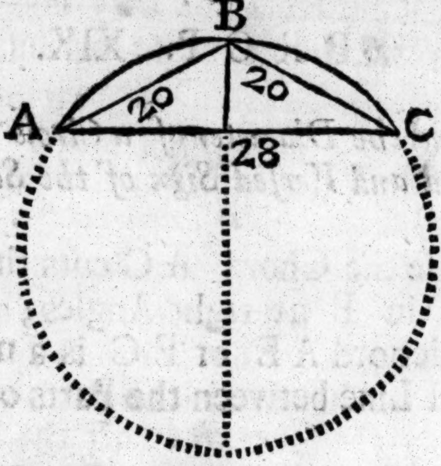
To find the Length of an Arch of a Circle.

Rule.

Multiply the Chord of half the Segment given by 8, and from that Product, ſubſtract the Chord of the whole Segment, and divide the Remainder by 3, the Quotient will be the Arch of the Segment.

Example.

Suppoſe A B C be a Segment of a Circle, in which the Chord of half the Arch A B, or B C is 20, and the Chord of the whole Arch A C is 28, and the Length of the Arch A B C is required.



Multiply the Chord of A B, or B C, which is 20 by 8, and the Product will be 160, from which ſubſtract the Chord of the whole Arch A C, which is 28, and the Remainder will be 132, which divide by 3, and the Quotient will give 44 for the Length of the Arch A B C.

20 The Chord of ½ the Arch A B.
8

160
28 The Chord of the whole Arch A C.

3) 132 (44 The Arch A B C.
12

12
12

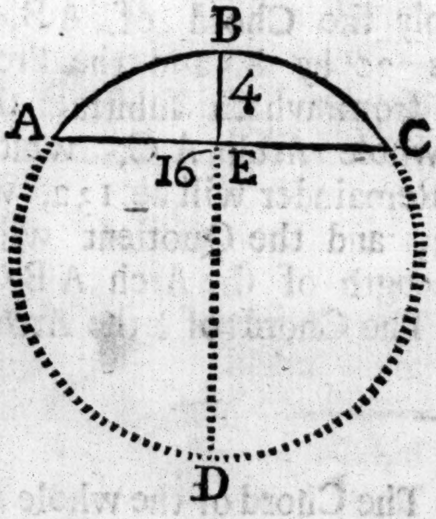
(o)

PROP.

PROP. XIX.

To find the Diameter of a Circle by having the Chord and Verſed Sign of the Segment.

Becauſe the Chord A C cuts the Diameter B D in E at right Angles; therefore the Semichord A E or E C is a mean proportional Line between the Parts of the Diameter B E and E D by the 6. 13 of *Euclid*; therefore if you ſquare the Semichord A E, or E C, and divide that ſquare by the Verſed Sign B E, the Quotient will give the Part of the Diameter E D, to which add the given Verſed ſign B E, and the *Sum* is the Diameter B D.



Ex-

Example.

Suppoſe A B C be a ſegment of a Circle given, whoſe Chord A C is 16 Feet, and the Verſed ſine B E is 4 Feet.

Firſt, halve the Chord *A C* 16, which is 8, which ſquared, makes 64 Feet; which divided by 4, the Quotient will be 16 for the Part of the Diameter E D, to which add B E 4, and the Sum will be 20, the Diameter of the Circle B D.

F

16 The Chord *A C.*

8 Half the Chord.
8

64 The ſquare of *A E.*

4) 64 (16 Feet, the part of the Diameter E D.
4

24
24

(0)
16 Feet E D.
4 B E.

20 The diameter B D.

PROP. XX.

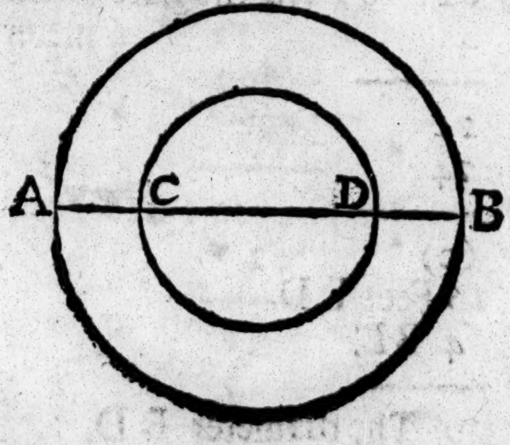
To find the Area of a Parallel Segment of a Circle.

Rule.

Find the Area of the greater Circle, as alſo the Area of the leſſer, and ſubſtract the Area of the leſſer Circle from that of the greater, and the Remainder will be the Area of the Segment required.

Example.

Suppoſe the Diameter of the greater Circle A B is 28 Feet, and the Diameter of the leſſer Circle C D is 22.6 Feet, and it be required to find the Area of the *Inter Annula*, or Ring.



Firſt, find the Area of the greater Circle, as directed *Prop.* 11, which you will find to be *616* Feet, alſo the Area of the leſſer Circle, which you will find to be 401.31 Feet, then ſubſtract 401.31 Feet, the Area of the leſſer Circle, from *616* Feet, the Area of the greater Circle, and the Remainder will be 414.69, the Area of the Segment required.

14 The Semidiameter.
14
56
14
196

As 7 : 22 : 196
22
392
392
7) 4312 (616 Feet.
42
11
7

42
42

(0)

11,3 The Semidiameter.
113

339
113
113

127 69

As 7 : 22 : 127.69
22

25538
25538

7) 2809.18 (401.31 feet.
28

009
7

21
21

8

7

(1)

616.00 Feet the Area of the greater Circle.
401.31 Feet the Area of the leſſer Circle.

214.69 Feet, Area of the Segment.

PROP. XXI.

To find the Area of the Segment of a Circle cut off by a Chord Line.

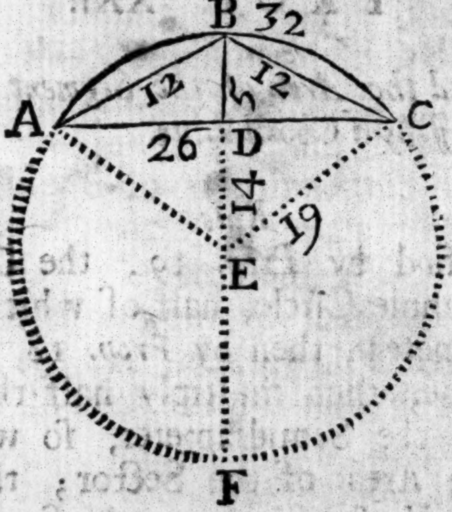
Rule.

Firſt find by *Prop.* 19, the Diameter of the whole Circle, half of which is the Semidiameter; then by *Prop.* 18, find the Arch Line, then multiply half the Arch line by the Semidiameter, ſo will you have the Area of the Sector; then ſubſtract the Verſed ſine from the Semidiameter, and the Remainder will be the Perpendicular of the Triangle; then multiply half the Chord of the Arch, or Baſe of the Triangle by the Perpendicular of the Triangle, and the Product will be the Area of the Triangle: Then ſubſtract the Area of the Triangle from the Area of the Sector,

ctor, and the Remainder will be the Area of the *S*egment required.

Example.

*S*uppoſe the Chord of the ſegment A C is 26 Feet, and the Verſed ſine B D is 5 Feet, and the Chord of half the Arch Line A B, or B C is 12 Feet, and it be required to find the Area of the Segment A B C.



First, take half of the Chord AC 26 Feet, which is 13, and ſquare it, the ſquare of which is 169, and divide it by the verſed ſine BD 5 Feet, and the Quotient will give 33 feet for the part of the Diameter D E F, to which add D B 5 Feet, and the *S*um will be 38 Feet, the Diameter of the Circle B E, the half of which is 19 Feet, the *S*emidiameter E F, or E C: Then to find the Arch Line A B C, multiply 12 Feet, the Chord of half the Arch by 8, and the Product will be 96, which divide by 3, and the Quotient will be 32 for the Arch line ABC, then multiply half the Arch line A B C 32 Feet, which is 16 Feet, by the Semidiameter EC 19 Feet, and the Product will give 304 Feet for the Area of the Sector A B C E; then ſubſtract the verſed ſine D B 5 Feet from the Semidiameter E C 19 Feet, and the Remainder will be 14 Feet, the Perpendicular of the Triangle E D; then multiply half the Chord of the Arch, or Baſe of the Triangle A C 26 Feet, which is 13 Feet by the Perpendicular of the Triangle E D 14 Feet, and the Product will give 182 Feet for the Area of the Triangle A E C, which ſubſtract from the Area of the Sector A B C E 304 Feet, and the Remainder will be 122 Feet, the Area of the *S*egment *A B C.*

26 The Chord of the given Arch A C.

13 Half the Chord of the Arch.
13

39
13
169

169 The ſquare thereof.

5) 169 (33 The part of the Diamet. DF.

15 5

19 38 The Diameter B F.

15

19 The ſemidiameter EC, or EB.

(4)

12 The Chord of half the Arch *A B*.

8

3) 96 (32 The arch line *A B C*.

9

06

6

(0)

32 The arch line *A B C*.

16 Half thereof.

19 The ſemidiameter E C.

144

16

304 The area of the ſector *A B C E*.

19 The ſemidiameter of the Circle EB.
5 The verſed ſine D B.

14 The Perpendicular of the Triangle D E.

26 The chord of the arch *AC*.

13 Half thereof.
14 The Perpendicular D E.

182 The area of the Triangle *ACE*.

304 The area of the ſector *ABCE*.
182 The area of the Triangle *ACE*.

122 The area of the ſegment *ABC*.

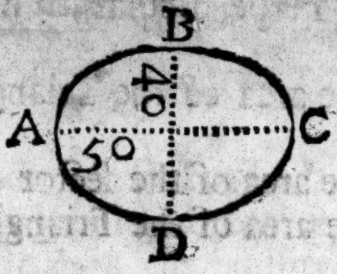
PROP. XXII.

How to find the Superficial Content of an Oval.

Multiply the length by the breadth, and that Product multiply by 11, and that Product divide by 14, and the Quotient ſhall give the Content of the Oval required.

Example.

Admit there is an Oval repreſented by the following Figure, whoſe length A C is 50, and breadth B D 40, whoſe ſuperficial content is required.



To find which, multiply the length 50 by the breadth 40, and the Product will be 2000, which multiply by 11, and the Product will be 22000, which divide by 14, and the Quotient will be 1571, which is the Content of the Oval required.

Having multiplied the two Axes B D 40, and A C 50, one into the other, as before, ſay,

As 1000 is to 785 : So is the Product of the two Axes to the Area of the Oval,

50 The great Axis A C.
40 The leſſer Axis B D.

2000 The Product.

As 1000 : 785 : 2000
785
10000
16000
14000
1570|000 The Area.

Or thus,

Multiply the Product of the two Axes multiplied one into the other by .7854, and the Product will be the Area of the Oval.

2000
.7854
8000
10000
16000
14000
1570.8000 The Area.

PROP.

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PROP. XXIII.

How to find the Area, or Superficial Content of a Parabola.

A Parabola is a Figure bounded by two Lines, one of which is curve, and the other ſtraight, and is formed by cutting a Cone with a Plain Parallel to the ſides thereof, as the following Figure; every Parabola is two Thirds of its circumſcribing Parallelogram; therefore to find the Area thereof, the Rule follows.

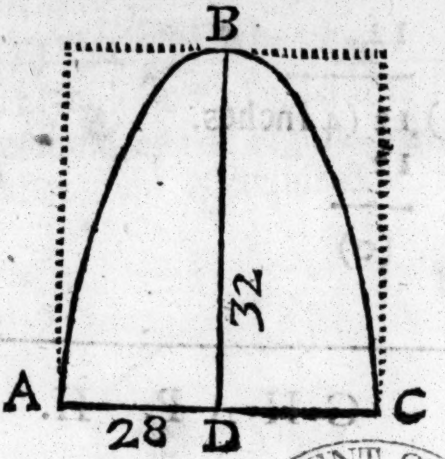
The Rule.

Multiply the Baſe line by the Perpendicular height, and multiply that Produce by 2, and divide the laſt Product by 3, and the Quotient will be the Area of the Parabola,

Example.

Suppoſe the Baſe line of the following Parabola be 28 Feet, and the Perpendicular height B D 32 Feet, and the Area thereof is required.

28 Feet.



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28 Feet.
32 Feet.

56
84

896 Feet.
2

3) 1792 (597 F. and 4 Inch. the Area of the Parabola A B C.
15

29
27

22
21

(1)

12

3) 12 (4 Inches.
12

(0)

C H A P. II.

How to Meaſure all ſorts of Regular Solids.

Having in the laſt Chapter ſhewed you how to meaſure any plain Superficies, which if well underſtood, the content of all ſolid Bodies, whoſe ends are of the ſame Dimenſions, will be found by the following Rule.

Rule.

Firſt find the ſuperficial content at the end by ſome of the Propoſitions foregoing, and multiply the ſame by the length, and the Product will give the ſolid content.

P R O P. I.

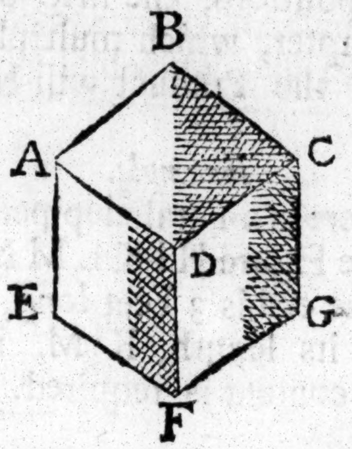
How to find the ſolid Content of a Cube.

Multiply its ſide into its ſelf, and that Product multiply by the ſide again, and that Product will be the ſolid content of the Cube deſired.

Example,

Example.

Admit there is a Cube, whoſe ſide is 6 Feet, repreſented by the Figure ABCDEFG, whoſe ſolid content is required.



To find which, multiply the ſide 6 by its ſelf, and the Product will be 36, which again multiply by 6, and the Product will be 216 Feet, which is the ſolid content of the ſaid Cube.

$$\begin{array}{r} 6 \\ 6 \\ \hline 36 \\ 6 \\ \hline 216 \end{array}$$

PROP.

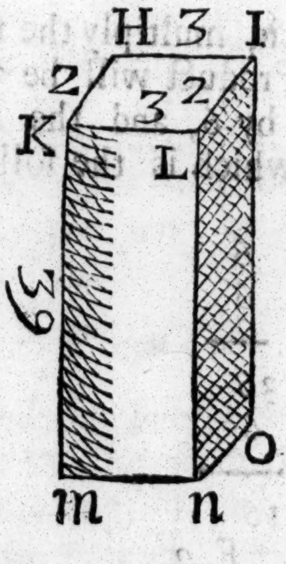
PROP. II.

How to find the Solid Content of a Parallelepipedon, or long Square.

Firſt find the ſuperficial content at the end by Propoſitions, the firſt, or ſecond of the laſt Chapter, which multiply into the length, and the Product will be the ſolid Content.

Example.

Admit there is a Parallelepipedon, repreſented by the Figure H I K L M N O, whoſe Square at the end is 3 Feet long, and 2 Feet broad, and its length, K M, is 39 Feet, whoſe ſolid content is required.



To find which, multiply the length at the top H I 3, by the breadth H K 2, and the Product will give 6, which is the ſuperficial content at the top, which multiply into the length K M 39 feet, and the Product will be 234 Feet, which is the ſolid content of the ſaid Parallelepipedon.

Feet.
3
2
———
6
39
———
234
———

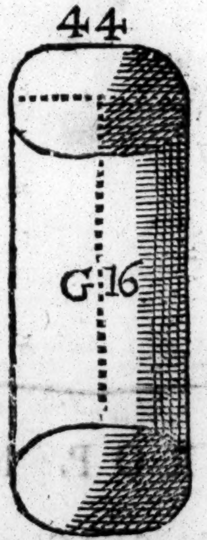
P R O P. III.

How to find the ſolid Content of a Cylinder.

Firſt find the ſuperficial content of the Circle at the Top or Baſe (by Propoſition 10, 11, or 12 of the laſt Chapter) then multiply it by the length, and the Product will be the ſolid content thereof.

Example.

Admit there is a Cylinder repreſented by the Figure G, whoſe circumference of the Circle at the end, or Baſe is 44 Inches, and the length of the Cylinder 16 Inches, whoſe ſolid content is required.



To find which, firſt find the ſuperficial Content of the Circle at the Top, or Baſe, by *Propoſition* the 11th of the laſt Chapter, which you will find to be 154 Inches, which multiply by the length 16 Inches, and the Product will be 2464 Inches, which is the Content of the Cylinder required; which you may reduce into Feet, by dividing the ſame by 1728, the number of Inches contained in a ſolid Foot, and the Quotient will give 1 Foot, and there will remain 636, which is $\frac{736}{1728}$ of a Foot, which is 5 Inches, 1 ſecond, 4 thirds.

Inches
44 The circumference at the End.
44

176
176

1936 The ſquare of the Circumference.

As 88 : 7 : 1936
7

88) 13552 (154 The Content of the End.
88

475
440

352
352

(0)

Inches.
154
16

924
154

1728) 2464 (1 Foot.
1728

736
12

1472
736

1728) 8832 (5 Inches.
8640

192
12

384
192

1728) 2304 (1 Second.
1728

576
12

1152
576

1728) 6912 (4 Thirds.
6912

(0)

But here I preſume it may not be improper to ſhew the great Error that common Meaſurers are guilty of in the meaſuring of Round Timber, whoſe Method is thus: They girt the Tree, or Piece of Timber about, and take the one fourth part of the Circumference for the true Square, which is very erroneous, as may appear by the laſt Example, where the Circumference, or Girt of the Cylinder was 44, and the Content of the Circle 154. Whereas, if you had taken the one fouth of the Circumference 44, which is 11, for the Square Root of the Circle, which multiplied into its ſelf, the Product is but 121; whereas the Content of the Circle is found to be 154, from which ſubſtract 121, and the Remainder will be 33. So much doth the *Common way* want of the true Content of the Circle; from whence it is evident, that according to the common way of meaſuring, there is loſt ſomething above the $\frac{1}{5}$ part of any Round Timber ſo meaſured.

But all that can be ſaid in Defence of this Cuſtom, is, That all Trees growing round, muſt be hewed ſquare, before they can be fit for any uſe; ſo this Advantage in meaſuring may be very well allowed for what goes to waſte in Chips, they being good for nothing but the fire; and although Meaſurers think not of this Excuſe, but take their Rule for an abſolute Truth, I preſume, was the firſt Occaſion of the Rule, though it is a very Unreaſonable Allowance, as may thus appear; the inſcribed Square of the Circle of the Cylinder, in the laſt Example, will be near 10 Inches, as you may prove by the following Proportion.

As 1.000 is to 0.225, ſo is the Circumference 44 to the inſcribed Square 9.900, which wants but very little of 10 Inches; and this is the greateſt Square ſuch a Round Piece of Timber can be hew'd into, and this multiplied into its ſelf, gives 98 Inches, and .010 Parts for its Content. Now if you add the Content of the inſcribed Square 98, and the true content of the Circle 154, together, their Sum will be

252, and the Middle, or Mean thereof (which is half their Sum) is 126, and the Content, after the common way, was but 121. So that you may ſee this Rule gives an indifferent Allowance, both to the Buyer and Seller. But I preſume, notwithſtanding all that hath been ſaid, that the true content ought to be given, and the Meaſure exactly known. And as to the Waſte thereof, Goodneſs, or Badneſs of the Timber, there ought to be an Allowance made in the Price.

PROP. IV.

How to know how much in Length of any Solid Body, having equal Baſes, goes to make a Solid Foot thereof.

Firſt, find the ſuperficial content at the End or Baſe, by which divide 1 (to wit, 1 ſolid foot), and the Quotient will be the Length that goes to make a Foot ſolid thereof.

Example.

Admit there is a piece of Timber, or any other ſolid Body, that is terminated at each end by two equal Geometrical Squares, whoſe ſide is 1.55, and it be required to know how much of the Length thereof goes to make a Foot Solid.

To perform which, firſt find the ſuperficial content at the End, or Baſe, by *Propoſition* the 1*ſt*, of the laſt *Chapter*, which you will find to be 2.4025, by which divide 1, and the Quotient will give .416 Feet, or 5 Inches, as in the following Work.

```
        1.55
        1.55
       -----
         775
        775
       155
       -----
2.4025 ) 1.0000000 ( .416
           96100
           -----
            39000
            24025
           ------
           149750
           144150
           ------
           (5600)
```

PROP.

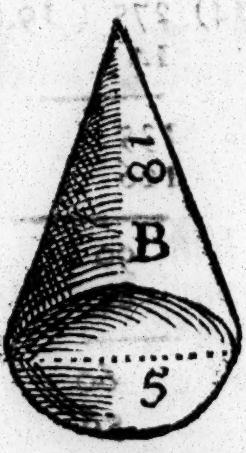
PROP. V.

How to find the ſolid Content of a Cone.

Firſt, find the ſuperficial content of the Circle at the Baſe, by (*Propoſition* the 10*th*, 11*th*, or 12*th* of the laſt *Chapter*) which multiply by $\frac{1}{3}$ of the Heighth, and the Product will be the ſolid Content of the Cone.

Example.

Admit there is a Cone repreſented by the Figure B, whoſe Diameter at the Baſe is 5 Feet, and its Heighth, or Altitude is 18 Feet, whoſe ſolid Content is required.



To find which, firſt find the ſuperficial content of the Baſe (by *Propoſition* the 11*th* of the laſt *Chapter*), which you will find to be 19.64, which multiply by $\frac{1}{3}$ of the heighth, which is 6, and the Product will give 117.84 feet, which is the ſolid content of the Cone required.

5 The Diameter at the Baſe,

5

25 The ſquare of the Diameter.

As 14 : 11 : 25

11

25

25

14) 275 (19.64.

14

135

126

90

84

60

56

(4)

Feet.
19.64 The content of the Baſe.
6 One third of the Perpendicular.
——— Height.
117.84 The ſolid Content of the Cone.

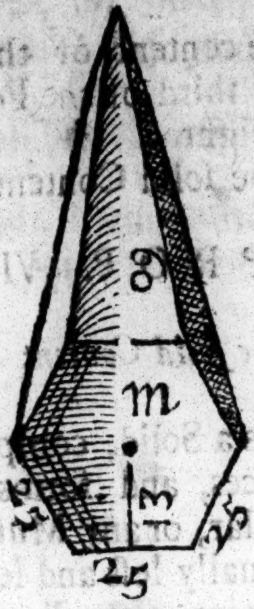
PROP. VI.

How to find the ſolid Content of a Pyramid.

A Pyramid is a Solid, comprehended under plain Surfaces, and forms a Triangular, Quadrangular, or any Mutangular Baſe, diminiſhing equally leſs and leſs, till it diminiſhes in a Point at the Top, as a Cone: To find the ſolid Content of any ſuch Figure; firſt, find the ſuperficial Content of the Baſe, by ſome of the Propoſitions of the laſt Chapter; which multiply into $\frac{1}{3}$ of its Altitude, or Heighth, and the Product will be the ſolid Content thereof.

Example.

Admit there is a Pyramid repreſented by the Figure M, whoſe Baſe is a Hexagon, the ſide of which is 25 Feet, and its Perpendicular heighth is 60 Feet, whoſe ſolid Content is required.



To perform which, firſt, find the ſuperficial Content of the Baſe, by *Propoſition* 5, of the laſt *Chapter*, *viz.* by multiplying half the Sum of the ſides, which is 75 Feet, by the Perpendicular (let fall from the Center to the midſt of one of the ſides), which will be 13 Feet, and the Product will give 975 Feet for the ſuperficial Content of the Baſe; which multiply by $\frac{1}{3}$ of the Heighth 20, and the Product will be 19500 Feet for the ſolid Content of the Pyramid required.

25 The ſide of the Baſe.
6 The number of the ſides.

150 The Sum of the ſides.

75 Half the ſum of the ſides.
13 The Perpendicular.

225
75

975 The content of the Baſe.
20 One third of the Height.

19500 The ſolid content of the Pyramid.

PROP. VII.

How to find the ſolid Content of the Segment of a Cone, or Pyramid.

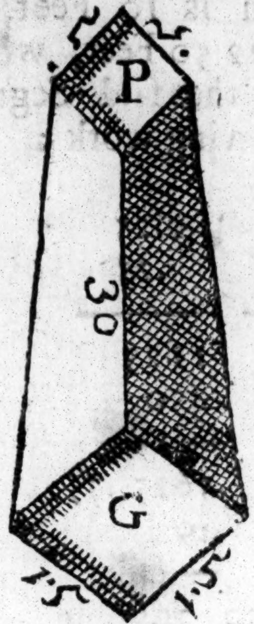
Here note, That all tapering Timber, or Stone, *&c.* whoſe Baſes are regular Figures, are Segments of either a Cone, or Pyramid.

To find the ſolid content of any ſuch Segment; firſt, find the ſuperficial content of both the Baſes, by ſome of the Propoſitions of the laſt *Chapter*, then multiply the ſuperficial Content of the greater Baſe by the ſuperficial Content of the leſſer, and extract the ſquare Root of that Product; then add that ſquare Root, and the ſuperficial Content of the two Baſes together, and their Sum multiply by $\frac{1}{3}$ part of the Length, and that Product will give the ſolid Content of the Segment required.

Example.

Admit there is a Segment of a Pyramid, whoſe Baſes are Squares, repreſented by the Figure P G, and the ſide of the great Square at G is 1.5 Feet, or 1 Foot 6 Inches, and the ſide of the leſſer at P is .5 Feet, or 6 Inches, and the Length of the ſaid Segment is 30 Feet, whoſe ſolid Content is required.

To



To find which, firſt find the ſuperficial Content of both the Ends by *Propoſition* the firſt of the laſt *Chapter*, the greater of which, you will find to be 2.25 Feet, and the leſſer 0.25 Foot, then multiply the ſuperficial Content at the greater End at G 2.25, by the ſuperficial Content of the leſſer at P .25, and the Product will be .5625 Foot; then extract the ſquare Root of that Product, which you will find to be .75 Foot, to which add the ſuperficial Content of the two Ends, and their Sum will be 3.25, which multiply by $\frac{1}{3}$ part of the Length, which is 10 Feet, and the Product will be 32.50 Feet, which is the ſolid Content of the ſaid Segment required, as in the following work:

1.5	.5	2.25	2.25
1.5	.5	.25	.25
			.75
75	.25	1125	
15		450	3.25
			10
2.25		.5625(.75	
		49	32.50
	1450	725	
		725	
		(0)	

If you work the ſame by Vulgar Arithmetick, you will find the Content to be 32 Feet 6 Inches.

Or,

The ſolid Content of either the Segment of a Cone, or Pyramid, whoſe Baſes are a Geometrical ſquare, may be found by the following Rule.

Rule.

Rule.

To the Product of the Top and Bottom Diameter, multiplied one by the other, add the Area's of both Baſes, and multiply that Product by one third part of the Length, and the Product will be the ſolid Content.

In the foregoing Example, the ſide of the greater Square is 1.5 Foot, and the ſide of the leſſer Square is .5 Foot, which multiplied one by the other, the Product will be .75 Foot, to which add the Area's of the two Ends, which are 2.25 Feet, and .25 Foot, and the Sum will be 3.25 Feet, which multiply by 10 Feet, the one third of the Length, and the Product will give, as before 32.50 Feet for the ſolid Content.

```
  1.5 The greater Baſe.
  1.5
 ----
   75
 15
 ------
 2.25 The Area of the greater Baſe.
 ------
   .5 The leſſer Baſe.
   .5
 ----
```

.25 The Area of the leſſer Baſe.

1.5 The greater Baſe.
.5 The leſſer Baſe.

.75 The Product of the two ſides.

2 25 The Area of the greater Baſe.
.25 The Area of the leſſer Baſe.
.75 The Product of the two ſides.

3.25 The Sum.
10 One third of the Length.

32.50 The ſolid Content.

And here I ſhall take notice of ſome Miſtakes, commonly made uſe of in Meaſuring of Timber, which I ſhall demonſtrate by Examples.

Firſt, when a Piece of Timber is not ſquare, but broader than it is thick, in this Caſe, it is common to add the Breadth and Thickneſs together, and take half the Sum for the true Side of the Square, which is very falſe, as will appear by the following Example.

Example.

Suppoſe a Piece of Timber to be 3 Feet 6 Inches broad, and 1 foot 6 Inches deep, and 20 Feet long, and it be required to find its ſolid Content.

Rule.

To perform which, the Erroneous way, firſt, add the Breadth 3.5 Feet, and the Depth 1.5 Foot together, and the Sum will be 5 Feet, the half of which will give 2.5 Feet for the true Square, which multiplied into its ſelf, the Product will be 6.25 Feet, which multiplied by 20, the Length, the Product will give 125.00 Feet for the ſolid Content.

```
3.5 The Breadth.
1.5 The Depth.
———
5.0 The Sum.
———
2.5
2.5
———
125
50
———
6.25
   20 The length.
———
125.00 The ſolid Content.
———
```

But to perform the ſame the true way, multiply the Breadth 3.5 Feet, into the Depth 1.5 Foot, and the Product will be 5.25 Feet, which multiply by the Length 20 Feet, and the Product will give 105 Feet for the true ſolid Content

3.5 The Breadth.
1.5 The Depth.

175
35

5.25
20 The Length.

105.00 The ſolid Content.

So that you ſee the falſe way gives 20 Feet more than the true one, for the Content.

The ſecond Error is, when a Piece of Timber is greater at one End than at the other.

To find the ſolid Content of which, the common way is, to add the Diameter of the Top and Bottom together in ſquare Timber, and take half the Sum for the true Square, which is alſo very falſe, as will appear as follows, in the foregoing Segment of a Pyramid, if you add the Diameter at both the Ends together, the Sum will be 2 Feet, the half of which is 1 Foot for the true Square, which multiplied into its ſelf, is ſtill only 1 for the Product, which multiplied by the Length 30, gives only 30 Feet for the ſolid Content; whereas, by the true way, it was found to be 32.50 Feet.

1.5 The greater Diameter.
.5 The leſſer Diameter.

2.0 The Sum.

1.0 The half Sum.
1.0

1.00 The Product.
30 The length.

30.00 The Content.

The true Content is	——	32.50
The falſe Content is	——	30.00
The Difference is	——	2.50

But if the tapering Timber, whoſe ſolid Content is required, be the Segment of a Square Pyramid, it may be found, as follows:

Rule.

Multiply the ſide of the greater Square by the ſide of the leſſer Square, and multiply that Product by 3, to which laſt Product add the Square of the Difference of the two ſides of the Squares, and multiply that Sum by one Third of the length, and the Product will be the ſolid Content.

Example.

In the aforegoing Segment, the ſide of the greater End at G, is 1.5 Foot, and the ſide of the leſſer at P, is .5 Foot, and the length 30 Feet, the ſolid Content of which is required.

1.5	The ſide of the greater Square G.
.5	The ſide of the leſſer Square P.
.75	The Product.
3	

2.25 The Product.
1.00 The ſquare of the difference of
——— the two ſides of the Squares.
3.25 The Sum.
10 The one third of the Length.
———
32.50 The ſolid Content.
———

1.5 The ſide of the greater Square
.5 The ſide of the leſſer ſquare.
———
1.0 The Difference.
1.0
———
1.00 The ſquare of the Difference.
———

But if the Piece of Timber, whoſe ſolid Content is required, be the Segment of a Pyramid, whoſe Baſes is a long ſquare, which is called a Priſmoid, the ſolid Content may be found by the following Rule.

To the greater Breadth, add half the leſſer Breadth, and multiply the Sum by the Depth of the greater Baſe, and reſerve the Product.

Then to the leſſer Breadth, add half the greater breadth, and multiply the Sum by

the

the Depth of the leſſer Baſe, and add that Product to the other Product reſerv'd; and multiply the Sum by the third part of the Length, and the Product will be the ſolid Content.

Example.

Suppoſe there is a Priſmoid, or Segment of a Pyramid, whoſe greater Baſe is 36 Inches broad, and 14 Inches deep, and the leſſer Baſe is 28 Inches broad, and 10 Inches deep, and the length is 6 Feet, whoſe ſolid Content is required.

To find which, firſt, add the greater Breadth 36 Inches, and half the leſſer Breadth, which is 14 Inches together, and the Sum will be 50 Inches, which multiply by the Depth of the greater Baſe 14 Inches, and the Product will be 700 Inches; then to the Breadth of the leſſer Baſe, which is 28 Inches, add half the Breadth of the greater Baſe, which is 18 Inches, and the Sum will be 46 Inches, which multiply by the Depth of the leſſer Baſe, which is 10 Inches, and the Product will be 460 Inches, to which, add the former Product 700 Inches, and the Sum will be 1160 Inches,

ches, which multiply by one third of the length, which is 2 Feet, the Product will be 2320, which divide by 144, and the Quotient will give 16$\frac{16}{144}$ Feet, or 1 Inch, 4 ſeconds for the ſolid Content.

36 The greater Breadth.
14 Half the leſſer Breadth.

50 The Sum.
14 The depth of the greater Baſe.

200
50

700 The Product.

28 The leſſer Breadth.
18 Half the greater Breadth.

46 The Sum.
10 The depth of the leſſer Baſe.

460 The Product.
700 The former Product.

1160 The ſum of the two Products.
2 The third part of the Length.

2320 The Content in ſquare Inches.

```
144 ) 2320 ( 16 Feet.
      144
      ———
       880
       864
      ———
  12) 16 ( 1 Inch.
      12
      ———
      (4)
```

P R O P. VIII.

How to find the ſolid Content of a Globe, or Sphere, the Diameter being given.

To find which, work by the following Proportion:

As 6 times 7, which is 42,
Is to 22,
So is the Cube of the Diameter, or Axis of any Globe,
To the ſolid Content thereof.

Or,

As $\left\{\begin{array}{l}21 \text{ to } 11\\ 1 \text{ to } .5236\\ 300 \text{ to } 157\end{array}\right\}$ So is the Cube of the Axis to the ſolid Content.

Example.

Admit there is a Globe, or Sphere repreſented by the Figure following, whoſe Diameter is 24 Inches, and it be required to find the ſolid Content thereof.

To perform which, firſt cube the Axis, or Diameter 24, whoſe Cube will be 13824 Inches ; then ſay : As 42 is to 22, ſo is 13824, to the ſolid Content of the Globe, or Sphere , which you will find to be $7241\frac{6}{42}$ Inches, which you may reduce to feet, by dividing it by 1728, the Inches in a ſolid

Foot, and the Quotient will be 4 Feet, and the Remainder will be $\frac{329}{1728}$ of a Foot, which reduced, will be $2\frac{492}{1728}$ Inches, as in the following Work:

24 The Axis of the Sphere.
24
———
96
48
———
576 The ſquare of the Axis.
24
2304
1152
———
13824 The Cube of the Axis.
———

As 42 : 22 : 13824
22
———
27648
27648
———
42) 304128 (72.41 Inches.
294
———
101

84

172
168

48
42

(6)

1728) 7241 (4 **Feet.**
6912

329
12

658
329

1728 (3948 (2 **Inches.**
3456

(492)

P R O P. IX.

How to find the ſolid Content of a Globe, or Sphere, the Circumference being given.

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To find which, work by the following Proportion,

As 1.0000
Is to 0.16887,
So is the Cube of the Circumference of any Globe
To the ſolid Content thereof.

PROP. X.

To find the ſolid Content of the Segment of a Globe, or Sphere.

The Segment of a Globe, or Sphere, is a ſolid Piece, cut off from the Globe, ſuch as A B C.

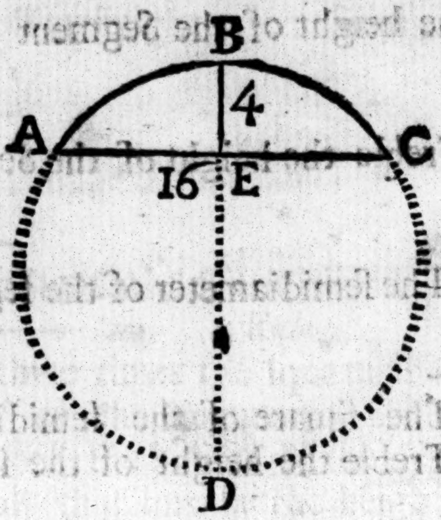
To find the ſolid Content of which,

Rule 1.

Multiply treble the Height of the Segment by the ſquare of half the Diameter of the Segment, and add to the Product the Cube of the Segment's height, and the Sum multiplied by .5235, and the Product will be the ſolid Content of the Segment.

Example.

Suppoſe in the Segment A B C E, the Diameter A C is 16 Feet, and the height B E is 4 feet, and it be required to find its ſolid Content. To



To perform which, multiply E B the height of the Segment 4 Feet by 3, and the Product will be 12 Feet, treble the height of the Segment, then ſquare the Semidiameter of the Segment A E, or E C 8 Feet, the ſquare of which is 64 Feet, which multiply by 12 Feet, treble the height of the Segment, and the Product will be 768 Feet, to which, add the Cube of 4 Feet, the height of the Segment, which is 64 Feet, and the ſum will be 832 Feet, which multiply by .5235, the Product will be 435.5520 Feet, which is the ſolid Content of the Segment of the ſphere A B C E.

Feet.
4 The height of the Segment E B.
3

12 Treble the height of the Segment.

Feet.
8 The ſemidiameter of the ſegm. A E.
8

64 The ſquare of the ſemidiameter.
12 Treble the height of the ſegment.

128
64

768 The Product.
64 The Cube of the height of the ſegm.

832 The ſum.
.5235

4160
2496
1664
4160

435.5520 The ſolid Content of the Segm.

Feet.
4 The height of the Segment E B.
4

16 The ſquare of the height of the Seg.
4

64 The Cube of the height of the Segm.

Rule 2.

To three times the ſquare of the Semidiameter of the Segment's Baſe, add the ſquare of the height of the ſegment, and multiply that ſum by the height of the ſegment, and multiply that Product by .5235, this laſt Product will be the ſolid Content of the ſegment.

Feet.
8 The ſemidiameter of the ſegment.
8

64 The ſquare of the ſemidiameter.
3

192 Treble the ſquare of the ſemidiameter.

Feet.
4 The height of the ſegment.
4

16 The ſquare of the Height.

192 Treble the ſquare of the Semidiameter.

208 The ſum.
4 The height of the ſegment.

832 The Product.
.5235

4160
2496
1664
4160

435.5520 The ſolid Content of the ſegment.

Rule 3.

From three times the Axis of the whole Globe, or Sphere, ſubſtract twice the Height of the Segment, and multiply the Remainder by the ſquare of the height of the ſegment, and the Product multiply by .5235, and that Product will be the ſolid Content of the ſegment of the ſphere.

Firſt, by the 19*th Prop.* of the laſt *Chapter*, find the Axis, or Diameter of the whole Spherer, or Globe, which you will find to be 20 Feet.

Feet.
8 The Diameter of the Segment.
8

4) 64 (16
4 4

24 20 The whole Axis of the Sph.
24

(0)

Inches.
20 The Axis of the Sphere.
3

60 Three times the Axis.
8 Twice the height of the Segm.

52 The Remainder.
16 The ſquare of the height of the Segment.

312
52

832 The Product..
·5235

4160

2496
1664
4160

435·5520 The ſolid Content of the Segment.

Feet.
4 The height of the Segment.
4

16 The ſquare of the height of the Segment.

PROP. XI.

To find the ſolid Content of a Spheroid.

A Spheroid is a ſolid, reſembling an Egg, and is in Proportion to a Sphere, whoſe Axis is equal to the Axes of Circumvolution, as the ſquare of the other Axes is to the ſquare of the ſame Axes of Circumvolution.

Therefore to find the ſolid Content of a Spheroid.

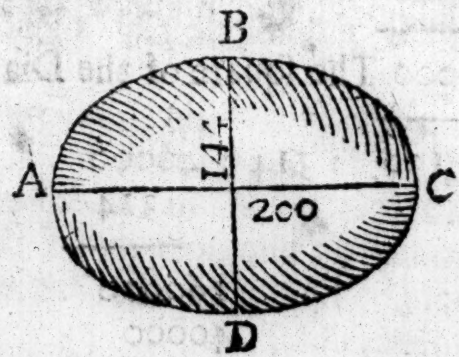
The Rule.

Firſt, find the ſolid Content of a Sphere, whoſe Axes, or Diameter is equal to the

Axes of Circumvolution, or Length of the *S*pheroid, which multiply by the ſquare of the leſſer Axes of the *S*pheroid, and divide that Product by the ſquare of the greater Axes, and the Quotient will be the ſolid Content.

Example.

*S*uppoſe in the *S*pheroid A B C D, the length, or Axes of Circumvolution A C is 200 Feet, and the other Axes B D, or Breadth is 144 Feet, and it be required to find the ſolid Content thereof.



Firſt, find the ſolid Content of a *S*phere, whoſe Diameter is equal to A C 200 Feet, which may be found as follows:

Firſt, ſquare the Diameter, or Axes A C 200 Feet, whoſe ſquare is 40000 Feet.

Then find the ſurface of the ſphere by the following Proportion :

As 100
Is to 314
So is the ſquare of the Diameter
To the ſurface of the Sphere, which you will find to be 125600 feet, which multiply by the ſemidiameter, or Radius of the Sphere, which is 100 Feet, and the Product will be 12560000 Feet, the one third of which is the ſolid Content of the ſphere, whoſe Diameter is 200 Feet, *viz.* 4186666 Feet, and 1152 Inches.

200 The Diameter A C.
200

40000 The ſquare of the Diameter.

As 100 : 314 : 40000
314

160000
40000
120000

1|00) 125600|00
100

3) 12560000 (4186666 Feet.
12: :::: 05

```
 ------
  05
   3
  -----
   26
   24
  -----
    20
    18
   -----
     20
     18
    -----
      20
      18
     -----
       20
       16
      -----
       (2)
     1728
    ------
3) 3456 ( 1152 Inches.
   3
  ----
   04
    3
  ====
```

15
15

06
6

(0)

Or,

The ſolid Content of the Sphere may be found by the following Proportion.

As 300
Is to 157,
So is the Cube of the Diameter
To the ſolid Content.

200 The Diameter A C.
200

40000 The ſquare of the Diameter.
200

8000000 The Cube of the Diameter.

As 300 : 157 : 8000000
157

56000000
40000000
8000000

1256000000

3|00) 12560000|00 (4186666 Feet.
12

5
3

26
24

20
18

20
18

20
18

20
18

```
          200
          1728
         ------
          1600
          400
         1400
          200
3|00) 3456|00 (1152 Inc.
      3..
     ----
      04
       3
      ---
       15
       15
      ---
        06
         6
        ---
        (0)
```

Having found the ſolid Content of a Sphere, whoſe Diameter is equal to the longeſt Axes of the Spheroid A C 200 Feet, to be 4186666 Feet, and 1152 Inches,

Multiply by the Square of the leſſer Axes B D 144 Feet, which is 20736 Feet, and the Product will be 86814720000 feet, which divide by the ſquare of the greater

Axes A C 200 Feet, which is 40000 Feet, and the Quotient will give 2170368 Feet for the ſolid Content of the Spheroid A B C D.

```
    144 The leſſer Diameter B D.
    144
   -----
    576
   576
  144
  ------
  20736 The Square of the leſſer Dia-
  ------ meter.

        Inches.
          1152
         20736
        -------
          6912
         3456
        8064
       23040
      ---------
1728) 23887872 (13824 feet.
      1728 · ··
      ---------
       6607
       5184
      ------
```

```
        14238
        13824
       ———————
         4147
         3456
        ——————
         6912
         6912
        ——————
          (0)

          4186666 Feet.
            20736
         ———————————
         25119996
        12559998
       29306662
      83733320
      ———————————
      86814706176 Feet.
            13824 Feet.
      ———————————
      86814720000 The Sum.

4|0000) 8681472|0000 (2170368
        8 . . . . . .
       ———
        06
         4
       ———
```

28
28

014
12

27
24

32
32

---

(0)

PROP. XII.

To find the ſolid Content of a Paraboloid.

A Paraboloid is a ſolid, equal to the half of a Cylinder, having the ſame Baſe, and the ſame Height.

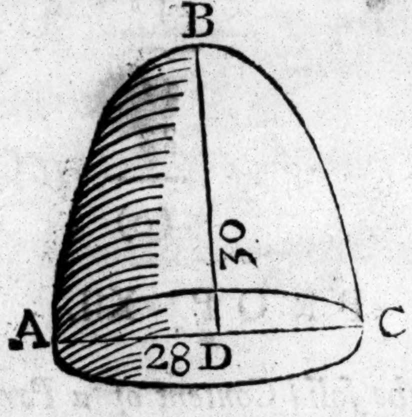
Therefore to find the ſolid Content thereof:

The Rule.

Firſt, find the Area of the Baſe, which multiply by the Height, and half of the Product will be the ſolid Content.

Example.

Suppoſe in the Paraboloid A B C D, the Diameter of the Baſe A C is 28 Feet, and the Perpendicular height B D 30 Feet, and it be required to find its ſolid Content.



Firſt, by *Prop.* the *9th* of the laſt *Chapter*, find the Area of the Baſe, which will be *616* Feet, which multiply by the Perpendicular height B D 30, and the Product will be 18480 Feet, the half of which is 9240 Feet, the ſolid Content.

28 The Diameter of the Baſe A C.

14 The Semidiameter A D.
14

56
14

196 The ſquare of the ſemidiameter.
As 7 : 22 : 196
22

392
392

7) 4312(616 ſeet.
42

11
7

42
42

(0)

Feet.
616 The Area of the Baſe.
30 The Perpendicular height.

18480 The Product.

9240 The ſolid Content.

PROP. XIII.

How to meaſure any Body that is hollow.

Admit it were required to find the ſolid Content of a hollow Tree, or of any other hollow Body whatſoever: To perform which, firſt, you muſt find the ſolid content thereof, as though it were not hollow; then find the ſolid Content of the Concavity, as though it were Maſſy, and ſubſtract it from the whole Content, and the Remainder will be the ſolid Content of the hollow Body.

PROP. XIV.

How to find the ſolid Content of any ſolid Body, of what Form ſoever; ſuch as Geometry can give no Rule for the Meaſuring thereof.

To perform which, take ſome convenient Veſſel, and fill the ſame to a convenient height with clean Water, and make a Mark juſt how high the Water reacheth; then put the Body, (whoſe ſolid Content is required) into the Water, which will cauſe the Water to riſe above the Mark; then take ſo much of the Water out of the Veſſel, as is raiſed above the Mark, and put the ſame into an hollow Cube, which have in readineſs for that Purpoſe; then find the ſolid Content of the ſaid Cube, ſo high as the Water reacheth, which ſhall be the ſolid Content of the ſaid Body required.

CHAP. III.

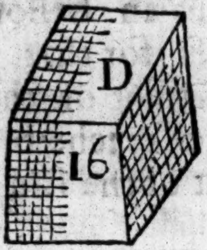
Of GAUGING.

GAuging of Veſſels is no other than finding the ſolid Content of the Concavities in Inches, as taught in the laſt *Chapter*, and dividing the ſame by the Number of cubick Inches, contained in a Gallon of the Liquor contain'd in the ſame, which according to the Eſtabliſhment of the *Exciſe* for Ale, is 282, and for Wine, 231 Inches.

PROP. I.

How to Gauge a Cubical Veſſel.

Admit there is a Cube-Veſſel repreſented by the Figure D, whoſe ſide is 16 Inches, and it be deſired to know how many Gallons of Wine, or Ale the ſame will hold.



To find which, firſt, find the ſolid Content of the ſaid Cube in Inches, as taught in *Propoſition* the firſt of the laſt *Chapter*, which you will find to be 4096 Inches, which reduce into Gallons, by dividing the ſame by 282 for Ale, or Beer, and the Quotient will be 14.5, which are the number of Gallons of Ale, or Beer the ſaid Cube will hold; and for Wine, divide the ſolid Content of the ſaid Cube by 231, and the Quotient will give 17.73 for the Number of Gallons of Wine the ſaid Cube will hold, as in the following Work:

```
16        282) 4096 (14.52
16             282
---            ----
96             1276
16             1128          256
```

```
 ____                   ______
  256                    1480
   16                    1410
 ______                 ______
 1536                     700
 256                      564
 ______                 ______
 4096                   (136)
          231) 4096 (17.73
               231
              _____
               1786
               1617
              ______
               1690
               1617
              ______
                730
                693
               _____
               (37)
```

To perform the ſame by the Line of Numbers:

I. *For* Ale, *or* Beer.

Extend your Compaſſes always from the Gauging Point, which for Ale is 16, into the ſide of the Cube, which in this Example is 16.8 and the ſame extent will reach from the ſaid 16, being turn'd twice over unto 14.5 Gallons of Ale, or Beer.

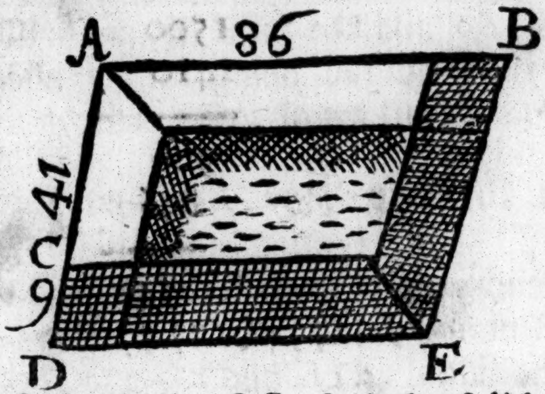
II. *For* Wine.

Extend your Compaſſes from the Gauging Point for Wine, which is always $15\frac{2}{10}$, into the ſide of the Cube 16, and the ſame extent being turn'd twice over, will reach from the ſaid 16, unto 17.73 Gallons of Wine.

PROP. II.

How to find the Contents of a Square Veſſel in Gallons of Ale, or Wine.

Admit there is a Square Veſſel repreſented by the Figure A B C D E, whoſe Length A B, is 86 Inches, and Breadth A C, 41 Inches, and it's Depth C D, 9 Inches; and it be required to know how many Gallons of Ale, Beer, or Wine, the ſaid Veſſel will hold.



To find which, firſt, find the ſolid Content of the ſaid Veſſel, as before taught in the Meaſuring of Solids ; which you will find to be 31734 Inches, which reduce into Gallons, by dividing the ſame by 282 for Beer, or Ale, and 231 for Wine, as in the laſt *Propoſition*, ſo will you find the ſaid Veſſel will hold 112.53 Gallons of Beer, or Ale, or 137.37 Gallons of Wine : As in the following Work :

```
  86        282) 31734 (112.53
  41             282
 ----            ----
  86             353
 344             282
 ----            ----
 3526              714
    9              564
 ----             ----
31734                          1500
```

1500
1410

900
846

54

231) 31734 (137.37
231

863
693

1704
1617

870
693

1770
1617

(153)

How to perform the ſame by the Line of Numbers.

To perform which, you muſt firſt find a mean Number between the Length A B,

86

86 Inches, and the Breadth A C, 41 Inches, by multiplying the Length 86, by the Breadth A C 41, and the Product will be 3526, and then extracting the ſquare Root of the ſaid Product, which Root is the Number required, which you will find to be 59.38 Inches.

Or Thus, by the Line of Numbers.

Take the middle way between 86, and 41, and you will find it the ſame as before, *viz.* 59.38 Inches.

Then for Ale.

Extend your Compaſſes from the Gauging point 16.8, to the mean Number 59.38 Inches, and the ſame Extent will reach from the Depth 9 Inches, turn'd twice over unto 112.53 Gallons of Ale, or Beer, as before.

For Wine.

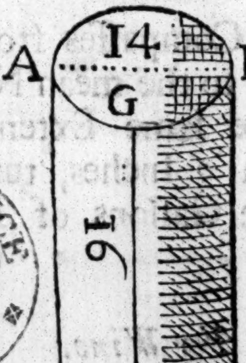
Extend your Compaſſes from the Gauging point for Wine 51.2, to the mean Number before found, 59.38 Inches, and the ſame Extent will reach from the Depth 9 Inches, turn'd twice over, to 137.37 Gallons of Wine, as before.

PROP.

PROP. III.

How to find the Contents of a Cylinder Veſſel in Gallons of Ale, Beer, or Wine.

Admit there is a Cylinder Veſſel repreſented by the Figure A B C G, whoſe Diameter A B is 14 Inches, and the Length thereof G C 16 Inches, and it be required to know how many Gallons of Ale, Beer, or Wine, this ſaid Veſſel will hold.



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To find which, firſt, find the ſolid Content of the ſaid Cylinder, as taught in *Propoſition* the third of the laſt *Chapter*, which you will find to be 2464 Inches; which reduce into Gallons, by dividing the ſame by 282 for Beer and Ale, and 231 for Wine; and you will find the ſaid Veſſel to hold 8.73 Gallons, of Beer, or Ale, and 10.66 Gallons of Wine, as in the following Work.

```
   7        As 7—22—49
   7                22
  ———              ————
  49                98
                    98
                   ————
               7) 1078(154
                    7   16
                   —   ———
                   37  924
                   35  154
                   ——  ———
                   28 2464
                   28 ————
                   ——
                   (0)

282) 2464(8.73      231) 2464 (10.66
     2256                231
     ————                ———
     2080                1540
     1974                1386
     ————                ————
```

1060	1540
846	1386
(214)	(154)

Or thus,

Square the Diameter AB 14 *Inches*, whoſe ſquare is 196 *Inches*, which multiply by the length G C 16 *Inches*, and the Product will be 2136 *Inches*, which divide by 359 for Beer, or Ale, and by 294 for Wine; ſo will you find, as before, the ſaid Veſſel will hold 8.73 Gallons of Beer, or Ale, or 10.66 Gallons of Wine.

How to perform the ſame by the Line of Numbers.

I. *For Ale, or Beer.*

Extend your Compaſſes from the Gauging point for Ale, or Beer 18.95, unto the Diameter 14, and the ſame Extent will reach from the Length 16, being twice turn'd over to 8.73 Gallons of Beer, or Ale.

II. *For Wine.*

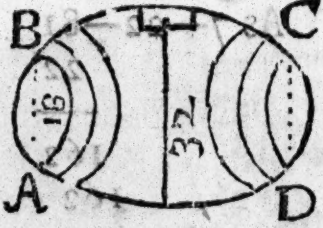
Extend your Compaſſes from the Gauging point for Wine 17.15, unto the Diameter 14, and the ſame Extent will reach, being twice turn'd over from the Length 16, to 10.66 Gallons of Wine.

PROP. IV.

How to find the Content of any Pipe, Butt, Barrel, Hogſhead, or Caſk.

Example.

Admit there is a Caſk repreſented by the Figure A B C D, whoſe Diameter at the Head A B is 18 *Inches*, and the Diameter at the Bung 32 *Inches*, and the Length is 40 Inches; and it be required to know how many Gallons of Ale, or Wine the ſame will hold.



To find which, there are ſeveral ways, but I ſhall only mention two, the firſt is Mr. *Oghtred*'s Method, which is thus, firſt, by *Propoſition* the 11*th* of the firſt *Chapter* of Meaſuring, find the Contents of the

Circles at the Bung and Head, which you will find to be 254.57 Inches for the Content of the Circle at the Head, and 804.57 *Inches* for the Area, or Content of the Circle at the Bung, then take two Thirds of the Content of the Circle at the Bung, which is 536.38 *Inches*, and one Third of the Content of the Circle at the Head, which is 84.85 *Inches*, which add together, the Sum will be 621.32 *Inches*, which multiply by the Length of the Veſſel 40 *Inch.* and the Product will be 24849.20 *Inches*, which is the ſolid Content of the ſaid Veſſel, which reduce into Gallons, by dividing the ſame by 282 for Beer, or Ale, and by 231 for Wine; ſo will you find the ſaid Veſſel to hold 88.11 Gallons of Ale, or 107.57 Gallons of Wine, as in the following Work.

```
 9    As 7—22—81
 9           22
 —          ——
81          162
           162
          ————
        7)1782(254.57$\frac{1}{7}$
           14   ————————
                 84.85
          ——    ——————
           38
           35
          ——
```

32

32
28

40
35

50
49

(1)

16
16

96
16

256

As 7—22—256
22

512
512

7) 5632 (804.57$\frac{1}{3}$
56

032
28

40
35

50
49

(1)

268.19
2

536.38

536.38|$\frac{2}{3}$ Of the Content of the Circle a
the Bung.
84.85|$\frac{1}{3}$ Of the Content of the Circle a
the Head.
621.23 The Sum.
40 The length of the Veſſel.
48 49.20 The ſolid Content of the Veſſel.

282) 24849.20 (88.11
2256
2289
2256
332
282
500
282
(218)

231) 24849.20 (107.57
231
1749
1617
1322
1155
1670
1617
(53)

Or

Or thus,

Square the Diameter at the Bung 32 *Inches*, whoſe Square is 1024 *Inches*, which double, and it makes 2048 *Inches*; then you muſt ſquare the Diameter at the Head 18 *Inches*, whoſe ſquare is 324 *Inches*, which you muſt add to the double of the Square of the Diameter at the Bung 2048 *Inches*, and their Sum will be 2372 *Inches*, which multiply by the Length of the Veſſel 40 *Inches*, the Product will be 94880 *Inches*, which you muſt divide by 1077 for Ale, 882 for Wine, ſo will you find as before, the ſaid Veſſel to hold $88\frac{104}{1077}$ Gallons of Ale, or $107\frac{606}{882}$ Gallons of Wine.

How to perform the ſame by the Line of Numbers.

To perform which, you muſt find a mean Diameter, between the Diameter at the Head and Bung; thus take the difference between the Diameter at the Bung 32 *Inches*, and the Diameter at the Head 18 *Inches*, which is 14 *Inches*, which you muſt always multiply by 7, and divide that Product by 10, and the Quotient you muſt add to the leſſer Diameter, and ſo will you have 27.8 *Inches* for a mean Diameter, then

I. *For Ale.*

Extend your Compaſſes from the Gauging point 18.95, unto the mean Diameter 27.8, and the ſame diſtance will reach from the Length 40, being twice turn'd over to 88.11 Gallons of Ale.

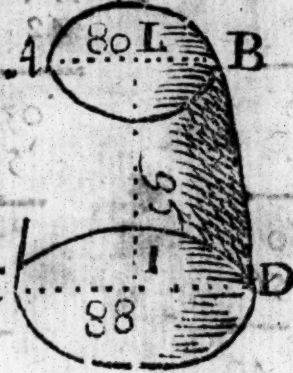
II. *For Wine.*

Extend your Compaſſes from the Gauging point 17.15, to the mean Diameter, and the ſame Extent will reach from the length 40, being twice turn'd over to 107.57 Gallons of Wine.

PROP. V.

How to Meaſure Brewers Tuns, or Marſh-Fatts.

Admit there is a Tun, or Marſh-Fat, repreſented by the Figure A B C D, whoſe Diameter at the bottom C D is 88 *Inches*, and the Diameter at the top A B 80 Inches, and its Depth L I 96 Inches, and it be required to know how many Barrels of Ale the ſame will hold.



To find which, firſt, find the ſolid Content of the ſame, as taught in *Propoſition* the *6th* of the laſt *Chapter*, which you will find to be 532625.92 Inches which divide by 282, the Number of Cubick Inches contained in a Gallon, and the Quotient will be 1888.74, the Number of Gallons of Ale the ſame will hold, which divide by 36, the Number of Gallons in a Barrel, and the Quotient will be 52.46, the Number of Barrels of Ale the ſame will hold, as in the following Work:

As 7—22—1600	As 7—22—1936
22	22
3200	3872
3200	3872

7)

```
7) 35200 (5028.57   7)42592(6084.57
   35                 42
   ----               ----
   020                059
    14                 56
   ----               ----
    60                 32
    56                 28
   ----               ----
     40                 40
     35                 35
   ----               ----
      50                 50
      49                 49
   ----               ----
      (9)                (0).

        6084.57
        5028.57
        -------
        4259199
       3042285
      4867656
     1216914
    30422850
    ---------
    30596686.1649 (5531.42
    .  .  .  .
    25
    ----
```

105

```
        105)559
            525
        ─────────
       1103)3466
            3309
        ─────────
      11061)15786
             11061
        ──────────
     110624)472516
            442496
        ──────────
    1106282)3002049
            2212564
            ────────
            (789485)
      6084.57
      5028.57
      5531.42
     ─────────
     16644.56
           32
     ─────────
     3328912
    4993368
    ──────────
    532625.92
```

```
                   36)
282)532625.92(1888.74(52.46
     282           180
     ---           ---
     2506           88
     2256           72
     ----          ---
      2465         167
      2256         144
      ----         ---
      2099         234
      1974         216
      ----         ---
       1252        (18)
       1128
       ----
       (124)
```

Or thus,

Square the Diameters of the Top and Bottom, then multiply one Diameter by the other, and add that Product and the Square of the two Diameters together, and multiply their Sum by the Depth of the ſaid Veſſel, and that Product divided by 1077, and the Quotient will give 1888, which is the Number of Gallons of Ale the ſaid Veſſel will hold; which reduce into Barrels, as before.

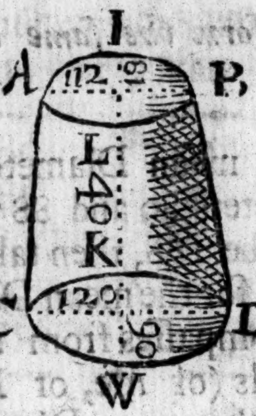
How to perform the ſame by the Line of Numbers.

Firſt, find a mean Diameter, thus, add the two Diameters 80 and 88 together, and their Sum will be 168, then take half thereof, which is 84, for the mean Diameter: Then extend your Compaſſes from the Gauging point for Barrels (of Ale, or Beer), which is $113\frac{7}{10}$, unto the mean Diameter 84, and the ſame diſtance will reach from the height 96, turn'd twice over, unto 52.44 Barrels.

PROP. VI.

How to meaſure an Oval Tun.

Admit there is an Oval Tun repreſented by the Figure A B C D, whoſe length at the Bottom C D is 120, and the Breadth K W 90, and the Length at the Top A B 112, and the Breadth I L 84, and the Depth of the Veſſel L K 40 Inches; and it be required to know how many Barrels of Ale the ſame will hold.



To find which, you muſt, firſt, find a mean Number between the Length and Breadth of the Oval at the Bottom, *viz.* 120 and 90, by multiplying the length 120 by the Breadth 90, and the Product will be 10800, and then extract the ſquare Root of that Product, and it will give 103.92 for the mean Number required; then likewiſe by the very ſame Method, you muſt find a mean Number between the length at the top 112, and the breadth 84, which you will find to be 97, which two mean Numbers you muſt add together, and their Sum will be 200.90; then take half thereof, which is 100.46, which multiply by the depth of the Tun 40, and the Product will be 4018.40, which divide by

359, and the Quotient will be the Number of Gallons of Ale the ſame will hold, which you will find to be 1119.331, which reduce into Barrels by dividing the ſame by 36, the Number of Gallons in a Barrel, and the Quotient will give 31.09 Barrels.

How to perform the ſame by the Line of Numbers.

To perform which, firſt, find the mean Numbers between the length and the breadth of the two Ovals, Thus, extend your Compaſſes from the Breadth of each Oval to its Length; then your Compaſſes being opened to half that diſtance, will reach from the Breadth to the mean Number deſired, by which Method you will find the mean Numbers, as before, to be 103.92 and 97, whoſe Sum is as before 200.92, the half of which is 100.46, which is the mean Diameter; then extend your Compaſſes from the Gauging point for Barrels, which is 113.7, to the mean Diameter 100.46, and the ſame will reach from the Depth 40, turn'd twice over, unto 31.09, the Number of Barrels of Ale the ſaid Veſſel will hold.

PROP. VII.

The Method of Gauging a fixed Tun, or Copper, and finding what it will hold every Inch deep, which is called Inching of a Tun.

Firſt, you muſt know, that *Brewer's* Tuns are generally ſo fix'd, as to leave a little for Conveniency of Cleanſing their Drink, which is uſually call'd the Dip, or fall of the Tun; to find the Content of which Dip, or Fall, the beſt way is, when the Tun is empty, to meaſure into the Tun ſo much Liquor, as will juſt cover the Bottom; for by that Means, you do not only find the true Fall, but alſo a true Level Plain over the Bottom of the Tun, from which, if the ſhorteſt Diſtance from the Liquor to the Top of the Tun, be ſet off from the Surface of the Liquor all round the Tun, you will have a true Plain at the Top of the Tun, to that of the Liquor.

Then to Inch the Tun, firſt, find the Area of the Top and Bottom of the aforefound Level Plain, and divide the Difference of the Area's by the Depth of the Level Plain, and the Quotient will be a fix'd Number, or an Addend, which being added to the leſſer Area, the Sum will be the Area of the next Inch, and being added to that Area, the Sum will be the Area of the third Inch; and ſo on from Inch to Inch, until the Area of every Inch be found the Sum of thoſe Area's, if the work be true, will be found to be equal to the Content of the Tun.

Example.

In the foregoing Tun, *Prop.* 5. whoſe Area of the greater End was found to be 6084.57 Inches, and the Area of the leſſer End 5028.57 Inches, let it be required to make a Table for 6 Inches deep, and to find its Content at that Depth.

To perform which, firſt, ſubſtract 5028.57 Inches, the Area of the leſſer End, from 6084.57 Inches, the Area of the greater End, and the Remainder will be 1056 Inches, which divide by 96 Inches the Length of the Tun, and the Quotient will be 11 Inches for the fixed Number, or the Addend, which added to the Area of the leſſer End 5028.57 Inches, the Sum will be 5039.57 Inches for the Area at 2 Inches from the leſſer End, to which, if you add 11 Inches, the Sum will be 5050.57 Inches the Area at 3 Inches, to which, if you add 11 Inches, the *Sum* will be 5061.57 Inches, the Area at 4 Inches; to which, if you add 11 Inches, the Sum will be 5072.57 Inches for the Area at 5 Inches, to which, if you add 11 Inches, the Sum will be 5083.57 Inches for the Area at 6 Inches; then if you add theſe ſeveral Area's together, their Sum will be 30336.42 Inches, which is the ſolid Content of the ſaid Tun 6 Inches deep from the leſſer End, as in the following Work:

6084.57 The Area of the greater End.
5028.57 The Area of the leſſer End.

1056.00 The Difference.

1 | 5028.57
11
2 | 5039.57
11
3 | 5050.57
11
4 | 5061.57
11
5 | 5072.57
111
6 | 5083.57
30336.42 The Total.

96) 1056 (11
96

96
96

(0)

From hence it evident, that if a Table was made for the whole Depth of the Tun 96 Inches, their Sum will be the whole Content of the Tun; and therefore thence it follows, that if any Number of theſe Area's, accounted from the Bottom, be added together, the Sum will ſhew the Content of the Tun at that Depth, which divided by 1077 for Ale, and 282 for Wine, and the Quotient will give the Quantity of Liquor, or Drink contain'd therein; and if the Tun has a Drip, it muſt be added thereto.

But if the ſides of the Tun are irregular, that is, not ſtraight from Top to Bottom; then the beſt way will be to divide the Tun into ſeveral Parts, each of 10, or 6 Inches deep, and find the Content of every ſuch Part, by taking the Diameter in the middle of every Part, and thereby find the Area, and multiply it by the Depth of the Part, and the Product will be the Content; and if the content of all theſe Parts be added together, the Sum will be the Content of the Tun.

Then if from the whole Content of the Tun, you ſubſtract the mean Area of the firſt part 6, or 10 times, according to the Depth you make the Parts, and from the Remainder ſubſtract the main Area of the ſecond Part, the number of times you make the Part Inches deep, and from that Remainder ſubſtract the main Area of the third Part, as often as you make that part Inches deep; and after the ſame manner proceed, until you have finiſhed all the Parts you divided the Tun into, you will by this Method make a Table, that will ſhew the Content of the Tun at any number of Inches deep.

Note, That if you take the Depth of the Parts in the ſide of the Tun, you muſt allow for the Difference between the Slant, and Perpendicular height in every Part.

There are other ways of Inching a Tun, which, for want of room, I am obliged to omit; but what I have ſaid already, I hope may be ſufficient.

PROP. VIII.

How to turn Barrels into Gallons, Beer Meaſure.

To perform which, work by the following Proportion:

As 1 is to 36, the Number of Gallons contained in a Barrel, ſo is the Number of Barrels given, to the Number of Gallons contained therein.

Exam-

Example.

Admit it be required to know how many Gallons of Beer are contained in 6 Barrels.

To perform which by Arithmetick, work by the Rule of *Three*, as followeth:

If 1 —— 36 —— 6
6
——
216 Gallons.
Anſwer 216 Gallons.

To perform the ſame by the Line of Numbers.

Firſt, ſet one Foot of your Compaſſes in 1, and extend the other to 36; then, with your Compaſſes at that diſtance, ſet 1 Foot in 6, and the other will reach to 216, the Number of Gallons contained in the ſaid 6 Barrels.

PROP. IX.

How to turn Gallons of Beer, or Ale into Wine.

To perform which, ſay, by the *Rule of Three*,

As 9 is to 11,
So is the Number of Ale-Gallons
To the Number of Wine.

Example.

Admit there is a Veſſel that contains 66 Gallons of Beer, and it be required to know, how many Gallons of Wine the ſame will hold.

To perform which by Arithmetick, work by the *Rule of Three*, as followeth:

If 9———11———66
66
———
66
66
———
9) 726 (80. *Anſwer* $80\frac{6}{9}$ Gall.
72
———
(06)

To perform which by the Line of Numbers.

Set one Point of your Compaſſes in 9, and extend the other to 11; then with your Compaſſes at that diſtance, ſet one Point in 66, and the other will reach to 80.6.

☞ *Here Note*, that the Proportion between 9 and 11 was found by Multiplying 282, the Number of Cubick Inches in an Ale Gallon by 9, and dividing that Product by 231, the Cubick Inches in a Wine Gallon, by which Method you will find 11 ſomething too much, tho' it is near enough for ordinary Uſe.

PROP. X.

How to turn Gallons of Wine into Gallons of Ale.

Example.

Admit there is a Veſſel that will hold 44 Gallons of Wine, and it be required to know how many Gallons of Ale the ſame will hold.

To perform which by Arithmetick, work by the *Rule of Three*, as followeth:

If 11 —— 9 —— 44
9
——
11) 396 (36
33 *Anſwer* 36 Gallons.
——
66
66
——
(0)

To perform the ſame by the Line of Numbers.

Set one Foot of your Compaſſes in 11, and extend the other to 9, then with your Compaſſes at that diſtance, ſet one Foot in 44, and the other will reach to 36, the Gallons of Ale the ſaid Veſſel will hold.

PROP. XI.

How to turn Gallons of Ale into Barrels.

Example.

Admit there is a Veſſel that holds 216 Gallons, and it be required to know how many Barrels are contained therein.

To perform which by Arithmetick, ſay, by the *Rule of Three*, If 36, the Number of Gallons contained in one Barrel, will have one Barrel, what will 216 Gallons have, and you will find the ſaid Veſſel to contain juſt 36 Barrels.

To perform the ſame by the Line of Numbers.

To find which, ſet one Foot of your Compaſſes in 36, and extend the other to

1, then with your Compaſſes at that diſtance ſet one Foot in 216, and turning the other towards 1, it will cut the Line in 36, the Number of Barrels contained in the ſaid Veſſel.

PROP. XII.

How to Gauge a Ship, and thereby to find how many Tuns her Burthen is.

To perform which, meaſure the Length of the Keel, the Breadth of the Midſhip Beam, and the Depth of the Hold; which three Numbers multiply one into the other, and divide the Product by 95, and the Quotient will give the true Burthen of any Merchant's Ship; but for Men of War, divide the Product by 100, because in Men of War there is allowance made for Ordnance, Maſts, Sails, *&c.*

CHAP. IV.

Of meaſuring Artificers Work, viz. *Carpenters, Joyners, Plaiſterers, Painters, Paviors, Glaſiers, Bricklayers,* &c.

BEcauſe the Method I have uſed in multiplying may be new to many, altho' it varies but very little from the Method uſed by the *Common Meaſurers*; for I work by *Croſs Multiplication*, as they do; all the difference is, I have ſuppoſed the *Inch* to be divided into 12 equal Parts, which I call *Seconds*, and each of thoſe Parts to be divided into 12 other equal Parts, which I call *Thirds, &c.* So is the Foot divided Duodecimally, ſo that 12 *Thirds* makes 1 *Second*, 12 *Seconds* 1 *Inch*, or *Prime*, 12 *Inches* 1 Foot.

Before I proceed, I ſhall ſhew you how to multiply after the Method I have uſed in this Chapter; to perform which, obſerve the following general Rules.

General Rules.

1. If you multiply Feet into Feet, the Product will be Feet.

2. I

2. If you multiply *Inches* into *Feet*, the Product will be *Inches*.

3. If you multiply *Inches* into *Inches*, the Product will be *Seconds*.

4. If you multiply *Seconds* into *Feet*, the Product will be *Seconds*.

5. If you multiply *Seconds* into *Inches*, the Product will be *Thirds*.

6. If you multiply *Seconds* into *Seconds*, the Product will be *Fourths*.

Example.

Admit there is given 17 *Feet*, 11 *Inches* 10 *Seconds*, to be multiplied by 6 *Feet*, 9 *Inches*, 4 *Seconds*.

To perform which, firſt, ſet down the Multiplicand and Multiplier, as in the following Work; then multiply the Feet in the Multiplicand 17, by the Feet in the Multiplier 6, and the Product will be 102 Feet; then multiply the Feet in the Multiplicand 17, by the *Inches* in the Multiplier 9, and the Product will be 153 *Inches*, which is 12 Feet 9 *Inches*, which ſet down as in the following Work, *viz.* the Feet under the Feet, and *Inches* under the *Inches*; likewiſe multiply the Feet in the Multiplier 6, into the *Inches* in the Multiplicand 11,

and

and the Product will be 66 *Inches*, which is 5 Feet 6 *Inches*, which likewiſe ſet down as you ſee in the Work ; then multiply the *Inches* in the Multiplicand 11, into the *Inches* in the Multiplier 9, and the Product will be 99 *Seconds*, which is 8 *Inches*, 3 *Seconds* ; ſet down the *Inches* under the *Inches*. and *Seconds* under the *Seconds*, as you ſee done : Then multiply the Seconds in the Multiplicand 10, into the Feet in the Multiplier 6, and the Product will be 60 Seconds, which is juſt 5 *Inches*, which ſet down under the *Inches* ; likewiſe multiply the Seconds in the Multiplier 4, into the Feet in the Multiplicand 17, and the Product will be 68 Seconds, which is 5 *Inches*, 8 *Seconds*, which ſet down as you ſee in the Work ; then multiply the Seconds in the Multiplier 4, into the *Inches* in the Multiplicand 11, and the Product will be 44 *Thirds*, which is 3 *Seconds*, 8 *Thirds* ; likewiſe multiply the Seconds in the Multiplicand 10, into the *Inches* in the Multiplier 9, and the Product will be 90 *Thirds*, which is 7 *Seconds*, and 6 *Thirds*, which likewiſe ſet down as in the Work ; then multiply the Seconds in the Multiplicand 10, into the Second in the Multiplier 4, and the Product will be 40 *Fourths*, which is 3 *Thirds* and 4 *Fourths*, which ſet down as in the Work; then add theſe ſeveral Products all up together, and the Sum will be 121 *Feet*, 10 *Inches*, 10 *Seconds*, 5 *Thirds*, and 4 *Fourths*, which is the Product deſir'd.

17	11	10		
6	9	4		
102				
12	9			
5	6			
	8	3		
	5	0		
	5	8		
		3	8	
		7	6	
			3	4
121	10	10	5	4

Example 2.

Admit it be required to multiply 165 Feet, 6 Inches, 4 Seconds by 79 Feet, 2 Inches, 3 Seconds.

To perform which, work in every reſpect as in the laſt Example, and you will find the Product to be 13107 Feet, 8 Inches, 9 Seconds, and 3 Thirds, as in the following Work.

165——6——4
79——2——3

1485
1155

13035
39——6
27——6
1——0
[illegible]——2——4
[illegible]——5——3
0——8
1——6
1——0

13107——8——9——3——0.

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But the following Method, I think, is more Expeditious, and Better.

Firſt, multiply the Feet in the Multiplicand and Multiplier, one into the other; then divide the Inches in the Multiplier into aliquot, or even Parts of a Foot, as you find contained therein, and take ſuch

Parts of the Multiplicand ; alſo divide the Inches of the Multiplicand into equal parts of a Foot, and take ſuch Parts of the Feet of the Multiplier, and add all theſe together, the Sum ſhall be the Product.

Example.

Admit it be required to multiply 75 Feet 9 Inches, by 37 Feet, 11 Inches :

Firſt, multiply 75 Feet by 37 Feet, and the Product will be 2775 Feet ; then divide 11 Inches into even Parts, which may be 4, 4, and 3, which is the $\frac{1}{3}$, $\frac{1}{3}$ and $\frac{1}{4}$, then take $\frac{1}{3}$ of 75 Feet 9 Inches, which is 25 Feet 3 Inches, which ſet down twice ; then take the $\frac{1}{4}$ of 75 Feet 9 Inches, which is 18 Feet 11 Inches and 3 Seconds ; then divide the 9 Inches into equal Parts, which may be 6 and 3, which is the $\frac{1}{2}$ and $\frac{1}{4}$ of a Foot, then take the $\frac{1}{2}$ of 37 Feet, which is 18 Feet and 6 Inches ; alſo the $\frac{1}{4}$ of 37 Feet, which is 9 Feet 3 Inches ; or, which is all one, you might have taken the $\frac{1}{2}$ of 18 Feet 6 Inches, which being ſet down, and added altogether, the Product will be 2872 Feet 2 Inches and 3 Seconds.

Feet

	Feet.	*Inches.*	
	75	9	
	37	11	
	525		
	225		
	2775		
1/3	—25	3	
1/3	—25	3	
1/4	—18	11	3
1/2	—18	6	
1/4	— 9	3	
	2872	2	3

But if the Feet of the Multiplier be under 12, then the Operarion may be perform'd, as in the following Example.

Suppoſe it be required to multiply 173 Feet 8 *Inches*, by 9 *Feet* 6 *Inches.*

173	8
9	6
1563	0
86	10
1649	10

Firſt, multiply 173 Feet 8 *Inches* by 9 Feet, ſaying, 9 times 8 is 72, which is juſt 6 Feet, ſet down 0 under the *Inches*, and carry 6; then 9 times 3 is 27, and 6 that you carried, is 33; ſet down 3, and carry 3, then 9 times 7 is 63, and 3 that you carried, is 66; ſet down 6, and carry 6; then 9 times 1 is 9, and 6 that you carry'd, is 15; then for the 6 *Inches*, take the half of 173 Feet 8 *Inches*, which is 86 Feet 10 *Inches*, which, being ſet down, and added together, gives 1649 Feet 10 *Inches* for the Product.

But if the Multiplier and Multiplicand be in *Feet*, *Inches*, and *Parts* of an *Inch*, and the Feet in the Multiplier be under 12, it may be perform'd as follows.

Example.

Admit it be required to multiply 97 *Feet*, 9 *Inches*, 6 *Seconds*, by 7 *Feet*, 11 *Inches*, 8 *Seconds*.

Firſt, multiply 97 *Feet*, 9 *Inches*, by 7 *Feet*, and the Product will be 684 *Feet* 6 *Inches*, and 6 *Seconds*; then divide 11 *Inches* into even Parts, which may be 4, 4, and 3, which is the $\frac{1}{3}$, $\frac{1}{3}$, and $\frac{1}{4}$; then take the $\frac{1}{3}$ of 97 *Feet*, 9 *Inches*, 6 *Seconds*, which is 32 *Feet*, 7 *Inches*, and 2 *Seconds*, which, ſet down twice, then take the $\frac{1}{4}$ of 97 *Feet*, 9 *Inches*, 6 *Seconds*, which is 24 *Feet*, 5 *Inches*, 4 *Seconds*, and 6 *Thirds*; then divide the 8 *Seconds* into aliquot Parts o 12, which may be 4 and 4, which is $\frac{1}{3}$ and $\frac{1}{3}$; then take the $\frac{1}{3}$ of 97 *Feet*, 9 *Inches* and 6 *Seconds*; ſo is the $\frac{1}{3}$ of 97 *Feet* 32 which, becauſe the Multiplier is *Seconds*, muſt be counted 32 *Inches*, which is 2 *Feet* 8 *Inches*, and the $\frac{1}{3}$ of 9 *Inches*, with the odd one that remains of 97, which is 12 in the next place, and makes the 9, being added thereto, 21, the third of which is 7, which are *Seconds*, and the $\frac{1}{3}$ of 6 is 2, which are *Thirds*; ſo is the *Third* of 97 *Feet*, 9 *Inches*, 6 *Seconds*, 2 *Feet*, 8 *Inches*, 7 *Seconds*, and 2 *Thirds*, which ſet down twice, and add all up together, and the Sum will be 779 *Feet*, 07 *Inches*, 4 *Seconds*, 10 *Thirds* for the Product.

	97	:	9	:	6			
	7	:	11	:	8			
	684	:	06	:	06			
$\frac{1}{3}$	32	:	07	:	02			
$\frac{1}{3}$	32	:	07	:	02			
$\frac{1}{4}$	24	:	05	:	04	:	06	
$\frac{1}{3}$	2	:	08	:	07	:	02	
	2	:	08	:	07	:	02	
	779	:	07	:	04		10	

But when the Feet in the Multiplier and Multiplicand are compound Numbers, it may be perform'd as in the following *Example.*

Admit 97 Feet, 9 Inches, 6 Seconds is to be multiply'd by 18 Feet, 7 Inches, and 5 Seconds.

Firſt, Multiply the Feet into Feet, and the Product will be 1746 Feet; then divide the 7 Inches into even parts of 12, which may be 4 and 3, which is the $\frac{1}{3}$ and $\frac{1}{4}$; then take the $\frac{1}{3}$ of 97 Feet, 9 Inches, 6 Seconds, which is 32 Feet, 7 Inches, and 2 Seconds; then take the $\frac{1}{4}$ of 97 Feet, 9 Inches, and 6 Seconds, which is 24 Feet, 5 Inches, 4 Seconds, and 6 Thirds; then divide the 5 Seconds into equal Parts of 12, which may be 4 and 1, which is the $\frac{1}{3}$ and $\frac{1}{12}$; then take the $\frac{1}{3}$ of 97 Feet, 9 Inches, and 6 Seconds, which is 32 Feet, 7 Inches, and 2 Seconds: But becauſe the Multiplier is Seconds, it muſt be ſet a Place forwarder to the Right Hand, that is, the 32 muſt be Inches, which is 2 Feet 8 Inches, therefore you muſt ſet down 2 Feet, 8 Inches, 7 Seconds, and 2 Thirds; then becauſe 1 Inch is $\frac{1}{4}$ part thereof, you may take the $\frac{1}{4}$ part of two Feet, 8 Inches, 7 Seconds, and two Thirds, which is 8 Inches, 1 Second, 9 Thirds, and 6 Fourths, which is the ſame as if you had taken the

12th part of *97* Feet, *9* Inches, and *6* Seconds; then for the *9* Inches in the Multiplicand, inſtead of multiplying 18 Feet by it, divide *9* into even parts, which may be *6* and 3, which is the $\frac{1}{2}$ and $\frac{1}{4}$; then take the $\frac{1}{2}$ of 18 Feet, which is *9*; and becauſe 3 is the $\frac{1}{2}$ of *6*, take $\frac{1}{2}$ of *9* Feet, which is 4 Feet *6* Inches, which is the ſame as if you had taken the $\frac{1}{4}$ of 18 Feet; and for the *6* Seconds, which ſhould alſo be multiply'd into 18 Feet, becauſe *6* is the half of 12, take the half of 18 Feet, which is *9*, which muſt be Inches, becauſe the *6* are Seconds; add all theſe together, and the Sum will be 1820 Feet, 8 Inches, 3 Seconds, 5 Thirds, and *6* Fourths, the Product deſir'd.

97 : 09 : 06
18 : 07 : 05

776
97

1746
32 : 07 : 02
24 : 05 : 04 : 06
2 : 08 : 07 : 02
— 08 : 01 : 09 : 06
9 : 00 : 00 : 00 : 00
4 : 06 : 00 : 00 : 00
09 : 00 : 00 : 00

1820 : 08 : 03 : 05 : 06

How

How to Meaſure Carpenters Work.

Carpenters Work, which is Flooring, Roofing, Partitioning, Joyſting, *&c.* is meaſured by the Square, that is 10 Feet every way, ſo that a Square containeth 100 ſuperficial Feet; in Meaſuring of which, the thickneſs is not conſider'd, but an Allowance made in the Price, according to the ſtrength, or ſlightneſs of the Work: So that the Meaſuring thereof is no other than the meaſuring of a Plain Superficies, as before taught; nor indeed is any other Work belonging to Building, except Bricklayers Work.

Example.

Admit there is a Floor, or Partitioning, which is 156 Feet 6 Inches in Length, and 55 Feet 4 Inches in Breadth, whoſe Content is required.

To perform which, multiply the Length by the Breadth, and the Product will be the Content in Feet and Inches, and then divide the Feet by 100, and the Quotient will give the Content in Squares, and the Remainder will be Feet.

To do which, by Croſs Multiplication, firſt, ſet down the Length and the Breadth, as you ſee in the following Work. Then multiply the Feet in the Length 165, by the Feet in the Breadth 55, and the Product will be 9075 Feet; then multiply the Feet in the Length 165, by the Inches in the Breadth 4, and the Product will be 660 Inches, which is 55 Feet, which ſet down under the Feet, as you ſee done; then multiply the Feet in the Breadth 55, by the Inches in the Length 6, and the Product will be 330 Inches, which is 27 Feet 6 Inches, which ſet down as in the Work, *viz.* the Feet under the Feet, and the Inches under the Inches; then multiply the Inches in the Length 6, by the Inches in the Breadth 4, and the Product will be 24, which are Seconds, 12 of which make an *Inch*, ſo that it is juſt two *Inches*, which ſet down as you ſee; then draw a Line, and add theſe ſeveral Products together, and the Sum will be 9157 *Feet* 8 *Inches*; then divide the Feet by 100, the Number of Feet contained in the Square, which is done by only cutting off the two firſt Figures towards your right Hand, *viz.* 57, which is 57 Feet, which divide by 25, the fourth part of 100, and the Quotient will be 2, which is two Quarters of a Square: So is the Content 91 Squares and a half, 7 Feet, 8 Inches, as in the following Work.

Feet. Inches.

165—06
55—04

825
825

9075
55—00
27—06
02—00

91|57—08—00

25) 57 (2
50

(7)

Or thus,

165—06
55—04

825
825

9075
55—02
27—06

91|57—08

Example 2.

Admit there is a Floor of Joyſting, that is 65 Feet 8 Inches long, and 15 Feet 4 Inches broad, whoſe Content is required.

To find which, work in every reſpect, as taught in the former Example, and you will find the Content of the ſame to be 10 Squares, 6 Feet, 10 Inches, 8 Seconds, as you ſee in the following Work.

Feet. *Inches.*
65—8
15—4
———
325
65
———
975
10—0
21—8
2—8
———
10|06—10·8
———

Or thus,

65—8
15—4
———
325
65
27—10—8
5
5
———
10|00—10—8
———

How

How to Meaſure the Roof of any Building.

Admit there is a Building that is 93 Feet long, from the out-ſide of the Wall at one End, to the out-ſide of the Wall at the other End, and the Breadth from the out-ſide of one Wall, to the out-ſide of the other Wall 36 Feet; and it be required to know how many Squares of Roofing there is in that Building.

To perform which, if the Building be true Roofed, you need not meaſure the Length of the Rafters, or the ſide-pieces, but take this for a general Rule, *viz.* that the Length of each Rafter is three Fourths of the Breadth of any Building; ſo in this Example, the Breadth of the Building being 36 Feet $\frac{3}{4}$ thereof, is 27 Feet, which is the Length of each Rafter, or Breadth of one ſide of the Roof, which being doubled, for ſo it muſt be, for both the ſides is 54 Feet, which you muſt multiply by the Length of the Building 93, and the Product will be 5022 Feet for the Content of the ſaid Roof, which reduce into Squares, by dividing the ſame by 100, ſo will you find 50 Squares, and 22 Feet, to be the Content of the Roof required, as in the following Work.

27 The length of the Rafter.
27
4)36(9 ——
36(3 54 The Sum.
——— 93 The length of the Build.
(0) 27 ——
162
486
———
50|22 The Product.
———

How to Meaſure the ſides of a Timber-building.

Example.

Admit there is a Timber-Building that is 36 Feet broad at each End, and 93 Feet long, and the height to the Rafters, or ſide of the Roof, is 69 Feet, whoſe Content is required.

To perform which, becauſe the two ſides are equal, and likewiſe the two Ends are equal, you need not ſtand to find the Content of each ſide ſeverally, but add all the four Sides together, whoſe Sum will be 258 Feet, which multiply by the height of the Building 69, and the Product will be 17802, which reduce into Squares, ſo will you find the Content of all the four ſides of f the ſaid Wood-Building to be 178 quares and 2 Feet, as in the following ork.

36 The Breadth
36
93 The length.
93

258
69 The height.

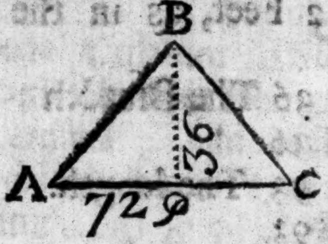
2322
1548

178|02.

How to Meaſure the Gable-End of a Timber-Building.

Example.

Admit it be required to find the Content of the Gable-end of a Building, whoſe breadth is 72 Feet from the out-ſide of one Wall, to the out-ſide of the other, the Gable-end of which Building is repreſented by the following Triangle ABC, whoſe Baſe A C, is 72 Feet, equal to the Breadth of the Building, and the Perpendicular B Q is 36 Feet.



To find the Content of which, multiply 72, the Baſe by 18, halve the Perpendicular, and the Product will give 1296 Feet, which reduce into Squares; ſo will you find the Content of the ſaid Gable end to be 12 Squares, 3 Quarters, and 21 Feet.

How to Meaſure Paving, Painting, Wainſcotting, Plaiſtering, &c.

Theſe are all meaſured by the Yard Square, containing 9 Feet, ſo that in Meaſuring of this ſort of Work, all that it differs from the former, is only inſtead of reducing the Content into Squares by dividing the ſame by 100, you muſt reduce it into Square Yards; by dividing the Feet by 9, the number of Feet in a Square Yard.

Example 1.

Admit there is a Court that is Paved, containing 76 Feet 6 Inches in Length, and

17 Feet

7 Feet and four Inches in Breadth, whoſe Content is required.

To find which, multiply the length of he ſaid Court 76 Feet and 6 Inches by the readth 17 feet and 4 Inches, as before aught, and the Product will be 136 feet, which feet divide by 9, the number of feet n a Square Yard, and the Quotient will be 147, and 3 will remain, which is 3 Feet; ſo is the Content of the ſaid Court found to be 147 ſquare Yards, and 3 Feet, as in the following Work.

```
    76—6                    Yards.
    17—4               9) 1326 (147
   ______                   ..
   532                      9
   76                      ___
   ____                     42
  1292                      36
    25— 4                  ___
     8— 6                   66
         2—0                63
 _____________             ___
  1326—0—0                  (3)
 _____________
```

Or thus,

```
 76—6
 17—4
──────
532
76
  25—6
   8—6
──────
1326—0
──────
```

Example 2.

Admit there is a piece of Wainſcot that is 6 feet long, and 3 feet 6 inches broad, whoſe Content is required.

To perform which, work in every reſpect, as in the foregoing Example, and the Anſwer will be 2 ſquare Yards, and 3 Feet, as in the following Work.

```
                                         Or thus,
  6—0                                        6—0
  3—6                                        3—6
─────        9) 21 (2 Yards                 ─────
 18             18                           18
  3—0         ────                            3
─────          (3)                          ─────
 21—0                                        21
```

Exam-

Example 3.

Admit there is a Room that is 9 feet 6 inches long, and 8 feet broad, and 7 feet high, which is Painted, whoſe Content is required.

To perform which, firſt, multiply the breadth by the height, and the Product will be the Content of one End of the Room, which, becauſe the two Ends are alike, double the ſame, and it will give the Content of both the Ends; then alſo multiply the length of the Room by the height, and the Product will be the Content of one of the ſides, which being doubled, becauſe the ſides are both alike, gives the Content of both ſides, which being added to the Content of both the Ends before found, the Sum is the Content of the 4 ſides of the Room required, which reduce into ſquare Yards, as before taught, by dividing the ſame by 9, and the Anſwer will be 27 ſquare Yards, 2 Feet, 8 Inches.

⁂ 9—6 The Length. 8—0
7 The height. 7—0
63 56
3—6 56
112
66

```
    66——6 The Product.
    66——6
    ——————
   133——0
   ——————
9)245(27 Yards.           133—00
  18                      112—00
  ——                      ——————
   65                     245—00
   63                     ——————
   ——
   (2)
```

*** *Note*: That the Dimenſions of a Room that is painted, is beſt taken by a String, becauſe of the Mouldings, which you bend as you pleaſe, and ſo meaſure the Mouldings with the reſt, which muſt be done, as being part of the Painting.

Example.

Admit there is a Room that is plaiſtered, that is 16 Feet 8 Inches long, and 10 Feet 6 Inches broad, and 7 Feet 11 Inches high, whoſe Content is required.

To perform which, find the Contents of the four ſides of the Rooms, as directed in the laſt Example, which you will find to be 430 Feet, 1 Inch, and 8 Seconds; then find the Content of the top of the Room, which is done by multiplying the Length by the Breadth, *viz.* 16 Feet 8 Inches, by 10 Feet 6 Inches, and the Product will be 175 Feet, which add to the Content of the Sides, and their Sum is the Content of the ſaid Room, which you will find to be 605 Feet, 1 Inch, and 8 Seconds, which reduce into Yards, as before taught, ſo will the Anſwer be 67 ſquare Yards, 2 Feet, 1 Inch, and 8 Seconds, as in the following Work.

Note, *That in meaſuring of Plaiſterers Work there is no Allowance made for the Windows, Doors or Chimneys.*

Feet. Inches.	
16—08 The Length.	
16—08	
10—06 The Breadth.	
10—06	
54—04 The Sum.	16—08 The Length.
7—11 The Height.	10—06 The Breadth.
378	160
49—06	6—08
2—04	8—00
03—08	04—00
430—01—08 The Pr.	175—00—00 The Pr.

Feet.	Inch.	Sec.
340	01	08
175	00	00
605	01	08

9)605(67
54
65
63
(2)

But here I judge it may not be improper to add how to find the ſuperficial Content of ſolid Bodies, becauſe Painters do very frequently paint ſuch Bodies.

How to find the ſuperficial Content of any Solid Body.

To find the ſuperficial Content of a Cylinder.

Rule.

Multiply the Circumference by th Length, and the Product will be the ſuperficial Content of the Convexity or outſide, to which if you add the ſuperficial Content of both the Ends, the Sum will be th ſuperficial Content of the whole *Cylinder.*

Exam

Example.

Suppoſe there is a round Pillar whoſe Girt or Circumference is 5 Feet 10 Inches, and the Length thereof is 12 Feet 8 Inches, and it be required to know how many Yards of Painting there is in the ſame.

To perform which, multiply the Girt 5 Feet 10 Inches, by the Length or Height 12 Feet 8 Inches, and the Product will be 73 Feet, 10 Inches, 8 Seconds, which is the ſuperficial Content of the Convexity, or outſide of the ſaid Pillar, which reduc'd into Yards, will be 8 $\frac{1}{9}$ Yards.

Feet.	*Inch.*	*Sec.*
05	10	
12	08	
60		
01	11	04
01	11	04
06		
04		
73	10	08

9)73(8 Yards $\frac{1}{9}$
72
(1)

But if the two Ends had been painted, you muſt have added the ſuperficial Content at each End, and ſo would you have had the ſuperficial Content of the whole *Cylinder.*

Example 2.

Suppoſe there is a *Cylinder* whoſe Circumference or Girt is 3 Feet 8 Inches, and its Length is 1 Foot 4 Inches, and it be required to find the ſuperficial Content thereof.

To perform which, multiply the Circumference or Girt 3 Feet 8 Inches, by the Length 1 Foot 4 Inches, and the Product will be 4 Feet, 10 Inches, 8 Seconds, the ſuperficial Content of the Convexity, or outſide of the *Cylinder* ; then, by *Prop.* 12. of the firſt *Chapter*, find the ſuperficial Content of the End, which will be 1 Foot 10 Seconds, which, becauſe both Ends are alike, ſet it down twice, and add them to the ſuperficial Content of the Convexity, and the Sum will be 7 Feet 4 Seconds, the ſuperficial Content of the whole *Cylinder*.

Feet.	**Inch.**	**Sec.**
03	08	
01	04	
03		
01	02	08
	04	00
	04	00
04	10	08
01	00	10
01	00	10
07	00	04

To find the ſuperficial Content of a Parallelepipedon.

Rule.

Add the ſides of the Baſe or End together, and multiply the Sum by the Length, and the Product will be the ſuperficial Content of the outſide, to which if you add the Area of each End, the Sum will be the ſuperficial Content of the whole *Parallelepipedon.*

Example.

Suppoſe there is a *Parallelepipedon* whoſe Ends are each 36 Inches broad, and 24 Inches deep, and its Length is 12 Feet, and it be required to find its ſuperficial Content.

To perform which, add firſt the Width and Depth of the Ends together, *viz.* 36 Inches, and 24 Inches, and the Sum will be 60 Inches, which multiply by the Length 12 Feet, and the Product will be 720, which divide by 12, and the Quotient will be 60 Feet, the ſuperficial Content of the outſide, to which if you add the ſuperficial Content of both the Ends, which you will find to be each 6 Feet, the Sum will be 72 Feet; the ſuperficial Content of the whole *Parallelepipedon.*

Inch.

36 The Breadth of the End.

24 The Depth of the End.

60 The Sum.

12 F. The Length.

120

60

12)720(60 Feet, the ſuperficial Content of the outſide.

72

Inch.
36 The Breadth of the End.
24 The Depth of the End.
———
144
72
———
144)864(6 Feet, the ſuperficial Content of the End.
864
———
(0)

Feet.
60 The Content of the outſide.
06 The Content of the End.
06 The Content of the End.
———
72 Feet, the ſuperficial Content of the whole *Parallelepipedon*.
———

To find the ſuperficial Content of a Cone.

Rule.

Multiply the Oblique Height by half the Circumference of the Baſe, and the Product will be the ſuperficial Content of the Convexity or outſide, to which if you add the Area of the Circular Baſe, the Sum will be the ſuperficial Content of the whole *Cone.*

Example.

Suppoſe there is a *Cone* whoſe Circumference at the Baſe is 88 Inches, and its Height is 18 Feet, whoſe ſuperficial Content is required.

To find which, multiply 44 Inches, half the Circumference of the Baſe, by 18 Feet the Height, and the Product will be 792 Feet, which divide by 12, and the Quotient will be 66 Feet, which is the ſuperficial Content of the Convexity, or outſide of the Cone, to which if you add the Area of the Baſe, which, by *Prop.* 12. of the firſt *Chapter*, will be found to be 616 Inches, or 4 Feet 3 Inches, the Sum will be 70 Feet 3 Inches, for the ſuperficial Content of the whole *Cone.*

Inch.

44 Half the Circumf. of the Baſe.
18 Feet, the Height of the *Cone.*

352
44

---

12)

```
———
12)792(66 Feet, the ſuperficial Con-
   72          tent of the outſide.
   ———
    72
    72
   ———
   (0)
```

Feet.	*Inch.*	
66	00	The Content of the outſide.
04	03	The Content of the Baſe.
70	03	The Content of the whole *Cone.*

To find the ſuperficial Content of a Pyramid.

Rule.

Multiply the ſlant Height by half the Sum of the ſides of the Baſe, and the Product will be the ſuperficial Content of all but the Baſe, to which if you add the Area of the Baſe, the Sum will be the ſuperficial Content of the whole *Pyramid.*

Example.

Suppoſe there is a *Pyramid* whoſe Baſe is a *Hexagon*, whoſe ſides are each 19 Inches, and the Height is 10 Feet, and it be required to find the ſuperficial Content thereof.

To find which, multiply half the Sum of the ſides 57 Inches, by the ſlant Height 10 Feet, and the Product will be 570, which divide by 12, and the Quotient will be 47 Feet 6 Inches, for the ſuperficial Content of all but the Baſe, to which if you add the Area of the Baſe, which you will find by *Prop.* 5. of the firſt *Chapter* to be 912 Inches, which is 6 Feet 4 Inches, the Sum will be 53 Feet 10 Inches, the ſuperficial Content of the whole *Pyramid.*

Inch.
19 The ſide of the *Hexag.* at the Baſe
06 The Number of the ſides.

114 The Sum of the ſides.

57 Half the Sum of the ſides.
10 Feet, the Height of the *Pyramid*

12)570(47 Feet.
48

90
84

(6)

Inch.
57 Half the Sum of the ſides of the Baſe
16 The Length of the Perpendicular.
———
342
57
———
144)912(6 Feet.
864
———
48
12
———
96
48
———
144)576(4 Inches.
576
———
(0)

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Feet. Inch.
47—06 The ſuperf. Cont. of all but the Baſe.
07—04 The Area of the Baſe.
———
54—10 The ſuperficial Content of the whole *Pyramid.*
———

To

To find the ſuperficial Content of the Segment of a Cone.

Rule.

Add the Circumference of both Ends together, and multiply half the Sum by the Length, and the Product will be the ſuperficial Content of all but the two Ends, to which if you add the Area of the two Ends, the Sum will be the ſuperficial Content of the whole Segment.

Example.

Suppoſe there is a Segment of a *Cone* whoſe Circumference at one End is 44 Inches, and at the other End 88 Inches, and the Length thereof is 48 Inches, and it be required to find the ſuperficial Content thereof.

To find which, add the Circumference of both Ends together, *viz.* 88 Inches, and 44 Inches, and the Sum will be 132 Inches, the half of which is 66 Inches, which multiply by 48 Inches the Length, and the Product will be 3168 ſquare Inches for the ſuperficial Content of all but the two Ends, which reduc'd into Feet, by dividing it by 144, will be 22 Feet, to which if you add the ſuperficial Content of both the Ends, which is 156 Inches, and *616* Inches, the Sum will be 3940 ſquare Inches for the ſuperficial Content of the whole Segment, which divided by 144, will give 27 Feet, 4 Inches, and 4 Seconds.

Inch.	
88	The Circumference at one End.
44	The Circumference at the other End.
132	The Sum.
66	Half the Sum.
48	The Length.
528	
264	
3168	The ſup. Cont. of all but the 2 ends.
616	The Area of one End.
156	The Area of the other End.

144)3940(27 Feet.
288

1060
1008

52
12

104
52

144)624(4 Inches.
576

48
12

96
48

144)576(4 Seconds.
576

(0)

To find the ſuperficial Content of the Segment of a Pyramid.

Rule.

Multiply half the *Pyrameter*, or Sum of the Sides of both the Ends, by the Length, and the Product will be the ſuperficial Content of all but the two Ends, to which if you add the Area of both the Ends, the Sum will be the ſuperficial Content of the whole *Segment.*

Example.

Suppoſe there is a Segment of a *Pyramid* whoſe Ends are Geometrical Squares, the ſide of the Greater of which is 1.5 Feet, and the ſide of the Leſſer is .5 Feet, and its Length is 16 Feet, and it be required to find the ſuperficial Content thereof.

To find which, firſt add the ſides at both Ends together, and their Sum will be 8 Feet, half of which is 4 Feet, which multiplied by 16 Feet the Length, the Product will be 84 Feet, which is the ſuperficial Content of all but the two Ends, to which if you add 2.25 the Area of the Greater End, and .25 the Area of the other End, the Sum will be 86.50 Feet, which is the ſuperficial Content of the whole Segment.

Feet.

6 The Sum of the ſides of the Greater End.
2 The Sum of the ſides of the other End.

8 The Sum.

4 Half the Sum.
16 The Length.

84 The ſuperf. Cont. of all but the two Baſes.
2.25 The Area of the Greater Baſe.
.25 The Area of the Leſſer Baſe.

86.50 The Content of the whole Segment.

To find the ſuperficial Content of a Sphere *or* Globe.

Rule.

$$\text{As}\left\{\begin{array}{l}7 \text{ to } 22,\\ 1 \text{ to } 3.14159,\\ 113 \text{ to } 355,\end{array}\right\}\text{ ſo is the Square of}$$

the Diameter to the ſuperficial Content required.

Example.

Suppoſe there is a Globe whoſe Diameter is 10 Inches, and it be required to find its ſuperficial Content.

10 The Diameter.
10

100 The Square of the Diameter.

As 7 to 22 : 100.

```
          100
          ———
  7)2200(314.2857 Inches:
     21
     ——
      10
       7
      ——
       30
       28
       ——
        20
        14
        ——
         60
         56
         ——
          40
          35
          ——
           50
           49
           ——
           (1)
```

To find the ſuperficial Content of the Segment of a Globe.

Rule.

As 1 is to the Chord of half the Segment, ſo is 3.1428571 to the ſuperficial Content of the Segment.

How to meaſure Glaſiers Work.

Glaſiers Work is meaſur'd by the Foot, therefore multiply the Length by the Breadth, as before, and the Product will be the Content required: But becauſe the Dimenſions of *Glaſiers* Work is taken more exact than any other ſort of Work, *viz.* in Feet, Inches, and part of an Inch, which makes the reſolving of Queſtions of that Kind, for the moſt part, ſomething more difficult than any of the foregoing; therefore I will ſhew you how to perform the ſame here, altho' I have ſhewed the ſame thing in the beginning of this *Chapter.*

Example.

Admit there is a Pane of Glaſs that is 6 Feet 8 Inches (or Primes) and 6 Seconds in Length, and 5 Feet 9 Inches (or Primes) and 3 Seconds in Breadth, whoſe Content is required:

To perform which, firſt ſet down the Dimenſions, as you ſee in the following Work, then multiply the Feet in the Length 6, into the Feet in the Breadth 5, and the Product will be 30, which ſet down under the Feet, as in the Work; then multiply the Inches in the Breadth 9, into the Feet in the Length 6, and the Product will be 54, which are Inches, which is 4 Feet 6 Inches, which likewiſe ſet down as in the Work; then multiply the Inches in the Length 8, into the Feet in the Breadth 5, and the Product will be 40, which likewiſe are Inches, which is 3 Feet 4 Inches, which likewiſe ſet down as you ſee in the Work; then multiply the Inches in the Breadth 9, into the Inches in the Length 8, and the Product will be 72, which are parts of Inches or Seconds, which is juſt 6 Inches; then multiply the Seconds in the Breadth 3, into the Feet in the Length 6, and the Product will be 18, which are Seconds, which is 1 Inch 6 Seconds; then multiply the Seconds in the Length 6, into the Feet in the Breadth 5, and the Product will be 30, which are likewiſe Seconds, which is 2 Inches, 6 Seconds; all which ſet down as in the following Work; then multiply the Seconds in the Breadth 3, into the Inches in the Length 8, and the Product will be 24, which are parts of Seconds or Thirds, which is 2 Seconds; then multiply the Seconds in the Length 6, into the Inches in the Breadth 9, and the Product will be 54, which likewiſe is Thirds, which likewiſe is 4 Seconds, and 6 Thirds, both which ſet down as you ſee in the following Work. *Laſtly*, Multiply the Seconds in the Breadth 3, into the Seconds in the Length 6, and the Product will be 18, which are parts of Thirds or Fourths, which is 1 Third and 6 Fourths, which ſet down as in the Work; then add all theſe Products together, and their Sum will be the Product of 6 Feet, 8 Inches, 6 Seconds, multiplied by 5 Feet, 9 Inches, and 3 Seconds, which is 38 Feet, 8 Inches, 6 Seconds, 7 Thirds, and 6 Fourths, which is the Content of the Pane of Glaſs required, as in the following Work.

Or thus,

Firſt, Multiply the Feet into the Feet, ſaying, 5 times 6 is 30; then divide the 9 Inches into aliquot or equal Parts of a Foot, which may be 6 and 3, which is the half and the one fourth; then take the half of 6 Feet, 8 Inches, and 6 Seconds, which is 3 Feet, 4 Inches, and 3 Seconds; then, becauſe 3 is the half of 6, take the half of three Feet, 4 Inches, and 3 Seconds, which is 1 Foot, 8 Inches, 1 Second, and 6 Thirds, which is the ſame as if you had taken the one fourth of 6 Feet, 8 Inches, 6 Seconds; then, for the 3 Seconds, becauſe it is an even part of 12, *viz.* the one fourth, take the one fourth of 6 Feet, 8 Inches, and 6 Seconds; which is 1 Foot, 8 Inches, 1 Second, and 6 Thirds; but becauſe the Multiplier is Seconds, it muſt be ſet a Place forwarder to the Right Hand, ſo that the 1 muſt be an Inch, ſo will it be 1 Inch, 8 Seconds, 1 Third, and 6 Fourths; then, inſtead of multiplying 8 Inches, 6 Seconds, by 5 Feet, firſt divide 8 Inches into aliquot Parts of 12, which may be 4 and 4, which is the one third, and one Third; then take the one third of 5 Feet, which is 1 Foot 8 Inches, which ſet down twice, then, for the 6 Seconds, which is the half of 12, take the half of 5 Feet, which is 2 Feet 6 Inches; but becauſe the Multiplier is Seconds, it muſt be placed a Place forwarder to the Right Hand, ſo that the 2 muſt be counted 2 Inches, and the 6, Seconds; all which ſet down, and add them together, and their Sum will give as before, 38 Feet, 8 Inches, 6 Seconds, 7 Thirds, and 6 Fourths for the Product, or Content of the Pane of Glaſs required.

```
Feet. Inch. Sec.
 6—8—6
 5—9—3
———————
30
 4—6
 3—4
    6—0
    1—6
    2—6
        2—0
        4—6
            1—6
———————————————
38—8—6—7—6
———————————————
```

Or thus,

```
Feet. Inch. Sec.
6—8—6
5—9—3
———————
30
3—4—3
1—8—1—6
    1—8—1—6
1—8
1—8
  2—6
———————————
38—8—6—7—6
———————————
```

Example.

Admit there is a pane of Glaſs that is 13 Feet, 6 Inches, and 5 Seconds long, and 6 Feet, 3 Inches, and 9 Seconds broad, whoſe Content is required.

To perform which, work in every reſpect as in the laſt *Example*, and its Content will be found to be 85 Feet, 5 Inches, 3 Seconds, and 9 Fourths, as in the following Work.

Feet. Inch. Sec.

13—6—5
6—3—9

78
3—3
3—0
1—6
9—9
2—6
4—6
1—3
3—9

85—5—3—0—9

Or thus,

Feet. Inch. Sec.

13—6—5
6—3—9

78
3—4—7—3
6—9—2—6
3—4—7—3
3—0—0—0—0
1—6—0—0
1—0—0—0

85—5—3—0—9

How to meaſure Bricklayers Work.

The meaſuring of which is more difficult than any ſort of Work that belongs to Building.

add them together, and their Sum will give as before, 38 Feet, 8 Inches, 6 Seconds, 7 Thirds, and 6 Fourths for the Product, or Content of the Pane of Glaſs required.

	Or thus,
Feet. Inch. Sec.	***Feet. Inch. Sec.***
6—8—6	6—8—6
5—9—3	5—9—3
30	30
4—6	3—4—3
3—4	1—8—1—6
6—0	1—8—1—6
1—6	1—8
2—6	1—8
2—0	2—6
4—6	
1—6	38—8—6—7—6
38—8—6—7—6	

Example.

Admit there is a pane of Glaſs that is 13 Feet, 6 Inches, and 5 Seconds long, and 6 Feet, 3 Inches, and 9 Seconds broad, whoſe Content is required.

To perform which, work in every reſpect as in the laſt *Example*, and its Content will be found to be 85 Feet, 5 Inches, 3 Seconds, and 9 Fourths, as in the following Work.

	Or thus,
Feet. Inch. Sec.	*Feet. Inch. Sec.*
13—6—5	13—6—5
6—3—9	6—3—9
78	78
3—3	3—4—7—3
3—0	6—9—2—6
1—6	3—4—7—3
9—9	3—0—0—0—0
2—6	1—6—0—0
4—6	1—0—0—0
1—3	
3—9	85—5—3—0—9
85—5—3—0—9	

How to meaſure Bricklayers Work.

The meaſuring of which is more difficult than any ſort of Work that belongs to Building.

In meaſuring of which, obſerve theſe general Rules following.

Firſt, Find the ſuperficial Content of each Wall, then find the ſuperficial Content of all the Windows and Doors in each Wall, and ſubtract them from the ſuperficial Content of the Wall in which they are, and the Remainder will be the Content of the Brick-work of each Wall in its given thickneſs.

Secondly, That all Walls of what thickneſs ſoever, muſt be reduced into a Brick and a half thick, by multiplying the Content by the number of half Bricks contained in the thickneſs of the Wall, and the Product will be the Content of the ſaid Wall in half a Brick thick, which divide by 3, the number of the half Bricks in a Brick and a half, and the Quotient will be the Content of the Wall in a Brick and a half.

Thirdly, That whereas Carpenters Work is meaſured by the Square, that is 10 Feet every way, ſo that the Square contains 100 Feet; ſo Brick-work is meaſured by the ſquare Rod, that is, 16 $\frac{1}{2}$ Feet every way, ſo that the Rod contains 272.25 Feet.

Fourthly, Having found the Content of all the Walls of any Building in a Brick and half thick, add them all into one Sum, and reduce the ſame into Rods, by dividing it by 272, the number of Feet in a Rod, and the Quotient will be the number of Rods of Brick-work contained in the ſaid Building.

Example.

Admit there is a Building in which the Walls, to the firſt Floor, which is 9 Feet 6 Inches high, are as follows, *viz.* the Wall on the front and the backſide are each 16 Feet 9 Inches long, the Wall on the front being three Bricks thick, and the Wall on the backſide three Bricks and a half thick, having in each a Door of the ſame Dimenſions, *viz.* 6 Feet 4 Inches high, and 2 Feet 6 Inches wide, and in the front Wall are two Windows of the ſame Dimenſions, each being 6 Feet 4 Inches high, and 3 Feet 6 Inches wide, and the Wall on the backſide hath two Windows, one of which is 5 Feet 6 Inches high, and 2 Feet 4 Inches wide, and the other is 5 Feet 11 Inches high, and 3 Feet 2 Inches wide, and the ſide Walls are each 24 Feet 9 Inches long, and 2 Bricks thick, and it be required to know how many Rods of Brick-work there is therein. To perform which, Firſt find the ſuperficial Content of the front Wall, which is done by multiplying its Length 16 Feet 9 Inches, into the Height of the Floor or Wall, which is the ſame, 9 Feet 6 Inches, and the Product will be 159 Feet, 1 Inch, 6 Seconds, which is the ſuperficial Content of the front Wall; and becauſe the front and back Wall are of the ſame Length and Height, it is likewiſe the ſuperficial Content of the back Wall, as in the following Work.

Or thus,

Feet.	*Inch.*	*Sec.*	*Feet.*	*Inch.*	*Sec.*
16	9		16	9	
9	6		9	6	
144			144		
8	0		8	4	6
6	9		4	6	
	4	6	2	3	
159	1	6	159	1	6

Then find the ſuperficial Content of the Doors and Windows in the front Wall.

Firſt, Find the Content of the Door, by multiplying its Height 6 Feet 4 Inches by its Breadth 2 Feet 6 Inches, and the Product will be 15 Feet 10 Inches, which is the ſuperficial Content of the Door.

Feet. *Inch.*
6——4
2——6
———
12
3——0
8
2
———
15——10
———

Or thus,
Feet. *Inch.*
6——4
2——6
———
12
3——2
8
———
15——10
———

Secondly, Find the Content of the two Windows in the front Wall, which are both alike, being each 6 Feet 4 Inches high, and 3 Feet 6 Inches wide, by multiplying the Height 6 Feet 4 Inches by the Width 3 Feet 6 Inches, and the Product will be 22 Feet 2 Inches, which is the Content of one of the Windows, which ſet down twice, and add them together, and their Sum will be 44 Feet 4 Inches, which is the Content of both the Windows.

Feet,	*Inch.*
6	4
3	6
18	
3	0
1	0
	2
22	2
22	2
44	4

Or thus,

Feet.	*Inch.*
6	4
3	6
18	
3	2
1	0
22	2
22	2
44	4

Having found the Content of the front Wall to be 159 Feet, 1 Inch, 6 Seconds, and the Content of the Door therein to be 15 Feet 10 Inches; alſo the Content of the Windows in the ſaid Wall to be 44 Feet 4 Inches, ſet down the Content of the Door and Windows one under the other, and add them together, and their Sum will be 60 Feet 2 Inches, which ſubſtract from the Content of the Wall, and the Remainder will be 98 Feet, 11 Inches, 6 Seconds, which is the Content of the Brick-work in the front Wall in the given thickneſs, *viz.* 3 Bricks thick.

Feet. Inch.
44—04 The Content of the Windows.
15—10 The Content of the Door.
———
60—02 The Sum.
———

Feet. Inch. Sec.
159—01—6 The Content of the front Wall.
60—02—0 The Content of the Door and Windows.
———
98—11—6 The Content of the Brickwork in 3 Bricks thick.
———

Then by the ſame Method find the Content of the Brick-work in the back Wall, whoſe ſuperficial Content being of the ſame Dimenſions as the front Wall is already found to be, 159 Feet, 1 Inch, 6 Seconds, alſo the Door therein being of the ſame Dimenſions with that in the front Wall, the Content thereof is likewiſe found to be 15 Feet 10 Inches; ſo that there remains only the Windows in this Wall to be found.

To perform which, multiply their Height into their Width, as before, ſo will you find the Content of the one to be 12 Feet 10 Inches, and of the other to be 18 Feet, 8 Inches, 10 Seconds, as in the following Work.

Feet.	Inch.
05	06
02	04
10	00
01	08
01	00
00	02
12	10

Or thus,

Feet.	Inch.
05	06
02	04
10	00
01	10
01	00
12	10

Feet.	Inch.	Sec.
05	11	00
03	02	00
15	00	00
02	09	00
00	10	00
00	01	10
18	08	10

Or thus,

Feet.	Inch.	Sec.
05	11	00
03	02	00
15	00	00
00	11	10
01	00	00
01	00	00
00	09	00
18	08	10

Then add the Content of Door and Windows together, and ſubtract the Sum from the Content of the Wall, as before, and the Remainder will be 111 Feet, 8 Inches, 8 Seconds, which is the Content of the Brick-work in the back Wall, in the given thickneſs of three Bricks and a half.

Feet.

Feet.	*Inch.*	*Sec.*	
15	10	00	The Content of the Door.
12	10	00	The Content of the Windows.
18	08	10	
47	04	10	The Sum.

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Feet.	*Inch.*	*Sec.*	
159	01	06	The Content of the back Wall
47	04	10	The Content of the Door and Windows.
111	08	08	The Content of the Brickwork in three ½ Bricks.

Then find the Content of the ſide Walls, which are both of one Thickneſs, and each 24 Feet 6 Inches long.

To perform which, multiply the Length 24 Feet 9 Inches, into the Height 9 Feet 6 Inches, and the Product will be 235 Feet, 1 Inch, 6 Seconds, for the Content of one of the ſide Walls, which being alike in Length, Height, and Thickneſs; therefore double the ſame, and you will have 470 Feet, 3 Inches, for the Brickwork of the ſide Walls in the given thickneſs, *viz.* 2 Bricks thick.

Feet.

Or thus,

Feet.	Inch.	Sec.	Feet.	Inch.	Sec.
24	09		24	09	
9	06		9	06	
216			216		
12	00		12	04	06
6	09		4	06	
	04	06	2	03	
235	01	06	235	01	06
235	01	06	235	01	06
470	03	00	470	03	00

Thus having found the Content of the Brickwork of all the Walls to the firſt Floor to be as follows, *viz.* the Wall on the Front 98 Feet, 11 Inches, 6 Seconds, in 3 Bricks thick; the Wall on the back 111 Feet, 8 Inches, 8 Seconds, in 3 Bricks and a half thick, and the two ſide Walls 470 Feet 3 Inches, in 2 Bricks thick.

After the ſame manner find the Content of all the Walls to the ſecond Floor, and ſo on, till you have found the Content of all the Brickwork in the Building you are to meaſure.

Having ſo done, there will remain nothing more to be done, only that you reduce the Content of each Wall into a Brick and a half thick, and add them into one Sum, and reduce the Sum into Rods by the foregoing Rule.

But becauſe in all Buildings you will find ſeveral Walls of one Thickneſs, therefore the beſt way is to ſet down the Content of all the Walls of one Thickneſs by themſelves, and all the Walls of another Thickneſs by themſelves, in Columns ruled for that purpoſe, as follows.

2 Bricks.	3 Bricks.	3 ½ Bricks.
F. I. S.	*F. I. S.*	*F. I. S.*
470—3—0	98—11—6	111—8—8

The content of the front Wall was found as before, to be 98 Feet, 11 Inches, 6 Seconds, in 3 Bricks thick, which ſet down in a Column marked at the Top with its Thickneſs, as you ſee is here done; and under the ſame, in that Column, place the Content of all the Walls of the ſame Thickneſs; And the like is to be done in all the reſt of the Walls of any Building whatſoever; then add each Column up, and reduce the Sum of each Column into a Brick and a half thick, which when done, add them altogether, and divide the Feet in the Sum by 272, the number of Feet in a Rod, and the Quotient will be the Rods of Brickwork in the ſaid Building; but in this *Example* the trouble of adding each Column is ſpared, becauſe there is but one Row of Figures in each Column, which, that the foregoing *Rules* may be better underſtood, we will call the Sum of each Column, to reduce which Columns into a Brick and a half.

Firſt, Take the Sum of the Column of 2 Bricks thick, which is 470 Feet 3 Inches, and multiply the ſame by 4, the number of half Bricks in 2 Bricks, and the Product will be 1881 Feet, which is the Contents in half a Brick thick, which divide by 3, the number of half Bricks in a Brick and a half, and the Quotient will be 627 Feet, which is the Content of all the Brickwork of 2 Bricks thick, in Brick and a half thick.

```
Feet.   Inch.
 470  :  03
          4
 ———————————
3)1881 : 00(627 Feet.
  18
  ——
   8
   6
  ——
  21
  21
  ——
  (0)
```

Then take the Sum of the Column of 3 Bricks thick, which is 98 Feet, 11 Inches, 6 Seconds, which multiply by 6, the number of half Bricks contained in the Thickneſs, and the Product will be 593 Feet 9 Inches, the Content in half a Brick thick, which divide by 3, the number of half Bricks in a Brick and a half, and the Quotient will be 197 Feet 11 Inches, as in the following Work.

Feet. Inch. Sec.
98—11—06
6
3)593—09—00(197 Feet.
3
29
27
23
21
2
12
3)33(11 Inches.
3
03
3
(0)

Then take the Sum of the Column of 3 ½ Bricks thick, which is 111 Feet, 8 Inches, 8 Seconds, and multiply it by 7, the number of half Bricks in the Thickneſs, and the Product will be 782 Feet 8 Seconds, which divide by 3, and the Quotient will be 260 Feet, 8 Inches, 8 Seconds, which is the Content in Brick and half thick.

Feet. Inch. Sec.
111—08—08
7

3)782—00—08(260 Feet.
6

18
18

02
12

3)24(8 Inches.
24

(0)

Having reduc'd the Sum of each Column, in this *Example*, into Brick and half thick, add them all together, and the Sum will be 1085 Feet, 7 Inches, 8 Seconds, which is the Content of all the Brickwork in this *Example* in Brick and half thick, which reduce into Rods, by dividing the Feet by 272, the Number of Feet in a Rod, and the Quotient will give 3 Rods, and the Remainder will be 269, which divide by 68, the fourth of 272, and the Quotient will give three Quarters of a Rod, as in the following Work.

Feet.	Inch.	Sec.
627	00	00
197	11	00
260	08	08
1085	07	08

272)1085(3 Rods.
816

68)269(3 Quarters.
204

(65)

So is the Content of the Brickwork, in Brick and half thick, 3 Rods, 3 quarters of a Rod, 65 Feet, 7 Inches, 8 Seconds.

What hath been ſaid, I ſuppoſe ſufficient to explain the foregoing *Rules*, ſo that to give you any more *Examples* of that kind will be needleſs: But becauſe there are ſome Walls that have a Water-table that is built, ſome 3, and ſome 5 Feet high, which Water-table is many times half a Brick thick, and ſometimes more; therefore I ſhall ſhew you how to meaſure any ſuch Wall.

To meaſure which, firſt find the Content of the Wall, as before taught, and reduce the ſame into Brick and half thick; then find the Content of the Water-table after the ſame manner, and reduce it likewiſe into Brick and half thick, then add the Content of the Water-table to the Content of the Wall, and the Sum will be the Content of the Wall, with the Water-table; which reduce into Rods, as before taught.

Example.

Suppoſe there is a Wall that is 2 Bricks thick, being 91 Feet 6 Inches long, and 17 Feet 3 Inches high, which has a Water-table half a Brick thick, and 3 Feet high, whoſe Content is required.

To perform which, firſt find the Content of the Wall, by multiplying the Height into the Length, and the Product will be 1578 Feet, 4 Inches, 6 Seconds, which reduce into Brick and half thick, by multiplying it by 4, the number of half Bricks contained in the Given Thickneſs, and dividing the Product by 3, the number of half Bricks contain'd in a Brick and a half, and you will find the Content of the Wall in Brick and half thick to be 2104 Feet 6 Inches, as in the following Work.

```
Feet.   Inch.   Sec.
  91—06
  17—03
 ------
637
91
----
1547
   8—06
  22—09
      01—06
------------------
1578—04—06
```

Or thus,

```
Feet.   Inch.   Sec.
  91—06
  17—03
 ------
637
91
----
1547
  22—10—06
   8—06
------------------
1578—04—06
```

```
     Feet.  Inch.  Sec.
     1578—04—06
              04 Feet. Inch.
   --------------
  3)6313—06—00(2104—06
    6
    --
    03
     3
    ---
    013
     12
    ---
      1
     12
    ---
  3)18
    18
    ---
    (0)
```

Thus find the Content of the Water-table, by multiplying its Height 3 Feet, into the Length of the Wall 91 Feet 6 Inches, and the Product will be 274 Feet 6 Inches, which reduce into Brick and half thick, which, becauſe the Thickneſs of the ſaid Water-table is half a Brick thick, is done by dividing by 3, and the Quotient will be 91 Feet 6 Inches, which is the Content of the ſaid Water-table in Brick and half thick, as in the following Work.

Feet. *Inch.*
91—06
3
———
3)274—06(91 Feet.
27
——
4
3
——
1
12
——
3)18(6 Inches.
18
——
(0)

Then add the Content of the Wall in a Brick and half thick, 2104 Feet 6 Inches, and the Content of the Water-table in Brick and half thick, 91 Feet 6 Inches together, and the Sum will be 2196 Feet, which is the Content of the Wall with the Water-table, which reduce into Rods, by dividing it by 272, the number of Feet in 1 Rod, and the Quotient will give 8 Rods, and 20 will remain, which are Feet: So is 8 Rods, 20 Feet, the Content of the Wall deſir'd, as in the following Work.

Feet. *Inch.*
2104—06 The Content of the Wall.
91—06 The Content of the Water-table.
——— ———
272)2196—00(8 Rods.
2176
———
(20)

How to Meaſure Chimneys.

The common way made uſe of by all Meaſurers, is thus: If the *Chimney* ſtands alone, without any party Wall adjoyn'd, ſo that the Wall makes not the back of the *Chimney*, as in Wood Building; then they girt it about, and take the Girt for the

Length, and the Height of the Room, or Story, for the Breadth, and multiply one by the other, and take the Product for the Content, in the ſame Thickneſs as the Jaums are of, which muſt be reduc'd into a Brick and a half, not deducting any thing for the Vacancy between the Floor (or Hearth) and Mantletree, becauſe of the gatherings of the Breaſt and Wings, to make room for the Hearth in the next Story.

But if the *Chimney* ſtands againſt a brick Wall, then the Wall at the back being the ſame with the Wall of the Houſe, and therefore being meaſur'd as part of the Wall, they only girt round to the Wall; multiply that into the Height of the Room, and take the Product for the Content of the *Chimney*, in the ſame Thickneſs as the Jaums are of, making no Deduction for the Vacancy between the Hearth and Mantletree, which Content muſt be reduc'd into Brick and half thick.

Example.

Suppoſe there is a *Chimney* whoſe Girt round below the Mantletree is 10 Feet 6 Inches, and the Height of the Room where the ſame ſtands, 9 Feet, and the Jaums of which is 2 Bricks thick, whoſe Content is required.

To find which, multiply the Girth 10 Feet 6 Inches, into the Height of the Room 9 Feet, and the Product will be 94 Feet 6 Inches, which is the Content of the *Chimney* in the ſame Thickneſs as the Jaums are, which is 2 Bricks thick, which you muſt reduce into Brick and half thick, as before directed; ſo will you find the Content in Brick and half to be 126 Feet, which is one Quarter of a Rod, and 58 Feet, as in the following Work.

Feet. *Inch.*
10——06 The Girt of the *Chimney*.
09——00 The Height of the Room.

94——06
04 The thickneſs of the Jaums.

3)378——00(126 Feet.
3

07
6

18 68)126(1
18 68

(0) (58)

Having by the foregoing Directions found the Content of all the *Chimneys*, you muſt next find the Content of the Shafts: To perform which, you muſt girt them about in the narroweſt place, and take that for the Length, and their Height for the Breadth, multiply one into the other, and the Product will be the Content of the Shafts: And if they are half Brick thick, you muſt ſet down the Thickneſs at one Brick thick, but if they be one Brick thick, as ſometimes they are, then you muſt ſet down their Thickneſs at a Brick and a half thick; and theſe Allowances are made in Conſideration of the Trouble and Charge of Scaffolding, *&c.*

How to Meaſure Tyling.

Tyling is Meaſur'd by the Square, containing 100 Feet, and is in every Reſpect the ſame with that of Rooſing, taught in Meaſuring of *Carpenters* Work.

Example.

Suppoſe there is a Roof of a Building that is tiled, the Length of which Building, from the outſide of the Wall at one end, to the outſide of the Wall at the other end, is 15 Feet, and the Breadth from the outſide of one Wall to the outſide of the other, is 9 Feet 6 Inches, and it be required to find the Content of the ſaid Tyling.

Feet. Inch.	*Feet. Inch. Sec.*	
4) 9—6	02—04—06	
8	03	
1	07—01—06	The Length of
12	07—01—06	the Rafters.
4)18	14—03—00	The Length of
16	15—00—00	the Building.
2	70	
12	14	
4)24	3—09—00	
24		
	2|13—09—00	
(0)		

The Anſwer is 2 Squares, 13 Feet, 9 Inches.

How to Meaſure Sawyers *Work.*

The *Sawyers* Meaſure their Work by the ſuperficial Foot, taking the Depth of the Carf, or piece of Timber for the Breadth, and the Length thereof for the Length, and having found the ſuperficial Content of one Carf (or cut of the Saw) multiply it by the number of Carfs in the ſame piece of Timber, and the Product will be the Content of the whole.

How to Meaſure Maſons *Work.*

Maſons Meaſure their Work ſometimes by the Foot Solid, ſometimes by the ſuperficial Foot, and in ſome places they Meaſure their Walling by the Rood, that is 21 Feet long, and 3 Feet high, which is 63 Square Feet.

How to Meaſure Earth *Work.*

In digging of Vaults, Cellars, and the like, they are commonly meaſured by the Solid Yard, containing 27 Solid Feet.

In making of Ramparts, Parapets, Ditches, &c. for Fortifications; alſo in making of Rivers, or Banks to keep out Water, &c. they are commonly meaſur'd by the Floor, containing 324 Solid Feet, which is 12 Cart Loads, for a Cart Load is a Solid Yard, or 27 Solid Feet: And the Cart ought to be 2 Feet, 8 Inches, and a half broad, at the Axletrees, within 2 Feet high, and 5 Feet long.

Thus I have ſhewn how to Meaſure all the Artificers Work I can at preſent think of, that work by Meaſure, tho' for want of Room I have given no *Example* in the three laſt, what I have ſaid I hope will be ſufficient for the meaneſt Capacity.

FINIS.

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